2020

Annual Report

TO OUR SHAREHOLDERS:

2020 was a year filled with innovation and accomplishment, flexibility and determination, as well as with uncertainty and challenge as we navigated the ongoing pandemic. COVID-19 impacted the world we live in, and as a company, we moved swiftly to adapt safely to rapidly changing conditions. We implemented measures to safeguard our employees, while also ensuring the safe and efficient operations of our facilities. Business continuity plans were quickly mobilized to ensure our ability to continue our R&D programs and the manufacture and shipment of our UniversalPHOLED® materials to our customers. As a result of the tremendous and commendable agility and focus of everyone at UDC, and our manufacturing partner PPG, we secured every customer shipment, fortified our first-mover advantage in the OLED ecosystem and positioned the Company to emerge stronger when this global crisis ends.

During the year, we announced long-term agreements with China Star Optoelectronics, the second largest panel maker in China; celebrated the 20-year anniversary of our strategic foundry partnership with PPG; established OVJP Corporation to advance the commercialization of our trailblazing manufacturing technology for OLED TVs; expanded our community education initiatives with the establishment of the *UDC, Inc. PHOLED Scholarship*, which aims to support a graduating Ewing, NJ (where UDC is headquartered) high school student pursuing a degree in the STEM field and partnered with the Smith Family Foundation, which assists with community programs in Trenton, NJ.

2020 was also another year of continued recognition for our Company. Universal Display was ranked 96th on *Fortune*'s 100 Fastest-Growing Companies global 2020 list. This is the fourth time that UDC has been named to the publication's annual ranking. UDC's commitment to diversity and inclusion was recognized by The Forum of Executive Women and we were named a *2020 Champion of Board Diversity*. Our Company was also named to *Newsweek*'s list of America's Most Responsible Companies 2021. Universal Display ranked 49th on the list, which recognizes the top 400 most responsible companies in the United States across 14 different industry subcategories.

On the financial front, 2020 revenue was $429 million (a new record high), operating income was $158 million, and net income was $133 million, or $2.80 per diluted share. We ended the year with $730 million in cash, cash equivalents and short-term investments, or approximately $15.45 of cash per diluted share.

Vision, innovation and reality are the foundational elements of UDC. Our ingenious team of scientists and engineers are continually discovering, developing and designing new OLED emissive material systems and technologies, and advancing our R&D roadmap with new milestone achievements.

- *Materials.* Our portfolio of energy-efficient, state-of-the-art phosphorescent materials continues to expand with next-generation reds, greens, yellows, and hosts, to meet our customers' ever-demanding and ever-evolving requirements of color point, efficiency, and lifetime. With respect to blue, we continue to make excellent progress in our ongoing development of a commercial phosphorescent blue emissive system.

- *OVJP*. We are making advances with our organic vapor jet printing (OVJP) manufacturing technology for mask-less, solvent-less, dry direct printing of large-area OLED panels. With our new OVJP Corporation team in place, we are focused on scaling our novel technology platform into a commercial equipment system. OVJP Corporation's first milestone is to develop an alpha system, anticipated to be ready during 2022.

- *Plasmonic*. In September 2020, *Nature* published our paper titled, "Plasmonic enhancement of stability and brightness in organic light-emitting devices," describing UDC's fundamental groundbreaking device architecture that may extend the lifetime and enhance the efficiency of OLED panels applicable to both displays and lighting applications. This work is part of our long-term R&D roadmap to continue enabling the OLED ecosystem with leading-edge technologies and best-in-class materials.

The world of OLEDs continues to broaden the imagination and transform what a consumer product can be. We are encouraged by the growing customer discussions and pipeline activity that we are seeing in the display and lighting markets. As we look to 2021, we expect to see meaningful revenue and OLED market growth, and are continuing to invest in our people, our infrastructure and in our innovation to further support our stakeholders and the OLED industry. In just the first few months of the new year, we announced that UDC Ireland Limited and PPG will jointly establish a new manufacturing site in Shannon, Ireland, that will be designed to double the production capacity and diversify the manufacturing base for UDC's phosphorescent emitters; signed new extended long-term agreements with LG Display, which further strengthens our nearly two-decade long partnership; celebrated our 25th year as a NASDAQ-listed company with the opening bell ceremony on April 12th; and were named to *Financial Times*' The Americas' Fastest-Growing Companies 2021 list.

We thank our employees around the world for their drive, desire, dedication, and heart in elevating and shaping Universal Display's accomplishments and advancements. To our customers and partners, we thank you for collaborations that create bright, beautiful, and brilliant products for displays and lighting. And to our shareholders, we thank you for your continued support as we deliver on our vision of turning innovation into reality.

Sherwin I. Seligsohn
Founder & Chairman of the Board

Steven V. Abramson
President & Chief Executive Officer

UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

FORM 10-K

(Mark One)

☒ **ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the fiscal year ended December 31, 2020

OR

☐ **TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934**

For the transition period from _____ to _____

Commission File Number 1-12031

UNIVERSAL DISPLAY CORPORATION

(Exact name of registrant as specified in its charter)

Pennsylvania	**23-2372688**
(State or other jurisdiction of incorporation or organization)	**(I.R.S. Employer Identification No.)**
375 Phillips Boulevard, Ewing, New Jersey	**08618**
(Address of principal executive offices)	**(Zip Code)**

Registrant's telephone number, including area code: (609) 671-0980

Securities registered pursuant to Section 12(b) of the Act:

Title of each class	Trading Symbol(s)	Name of each exchange on which registered
Common Stock, $0.01 par value	**OLED**	**The NASDAQ Stock Market LLC**

Securities registered pursuant to Section 12(g) of the Act: None

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes ☒ No ☐

Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or Section 15(d) of the Act. Yes ☐ No ☒

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes ☒ No ☐

Indicate by check mark whether the registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T (§ 232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit such files). Yes ☒ No ☐

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company or an emerging growth company. See the definitions of "large accelerated filer," "accelerated filer," "smaller reporting company," and "emerging growth company" in Rule 12b-2 of the Exchange Act.

Large accelerated filer	☒	Accelerated filer	☐	Emerging growth company	☐
Non-accelerated filer	☐	Smaller reporting company	☐		

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. ☐

Indicate by check mark whether the registrant has filed a report on and attestation to its management's assessment of the effectiveness of its internal control over financial reporting under Section 404(b) of the Sarbanes-Oxley Act by the registered public accounting firm that prepared or issued its audit report. ☒

Indicate by check mark whether the registrant is a shell company (as defined in Rule 12b-2 of the Exchange Act). Yes ☐ No ☒

The aggregate market value of the voting and non-voting common equity held by non-affiliates of the registrant computed by reference to the closing sale price of the registrant's common stock on the NASDAQ Global Market as of June 30, 2020, was $6,378,877,535. Solely for purposes of this calculation, all executive officers and directors of the registrant and all beneficial owners of more than 10% of the registrant's common stock (and their affiliates) were considered affiliates.

As of February 16, 2021, the registrant had outstanding 47,109,309 shares of common stock.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the registrant's Proxy Statement for the 2021 Annual Meeting of Shareholders, which is to be filed with the Securities and Exchange Commission no later than April 30, 2021, are incorporated by reference into Part III of this report.

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CAUTIONARY STATEMENT
CONCERNING FORWARD-LOOKING STATEMENTS

This report and the documents incorporated by reference in this report contain some "forward-looking statements" within the meaning of Section 27A of the Securities Act of 1933 and Section 21E of the Securities Exchange Act of 1934. Forward-looking statements concern possible or assumed future events, results and business outcomes. These statements often include words such as "believe," "expect," "anticipate," "intend," "plan," "estimate," "seek," "will," "may," "project" or similar expressions. These statements are based on assumptions that we have made in light of our experience in the industry, as well as our perceptions of historical trends, current conditions, expected future developments and other factors we believe are appropriate under the circumstances.

As you read and consider this report, you should not place undue reliance on any forward-looking statements. You should understand that these statements involve substantial risk and uncertainty and are not guarantees of future performance or results. They depend on many factors that are discussed further under Item 1A (Risk Factors) below, including:

- successful commercialization by organic light emitting diode (OLED) manufacturers of products incorporating our OLED technologies and materials and their continued willingness to utilize our OLED technologies and materials;
- impacts of the COVID-19 pandemic on the global economy, consumer spending and global supply chains, as well as volatility in and disruption of financial markets;
- the adequacy of protections afforded to us by the patents that we own or license and the cost to us of maintaining, enforcing and defending those patents;
- our ability to protect our patented and non-patented intellectual property;
- our exposure to and ability to defend third-party claims and challenges to our existing and future intellectual property rights;
- our ability to maintain our competitive position following the expiration of our fundamental phosphorescent organic light-emitting diode (PHOLED) patents;
- our ability to form and continue strategic relationships with manufacturers of OLED products;
- the payments that we expect to receive under our existing contracts with OLED manufacturers and the terms of contracts that we expect to enter into with OLED manufacturers in the future;
- the potential commercial applications of and future demand for our OLED technologies and materials, and of OLED products in general;
- our ability to offer and our customers' willingness to continue to purchase our materials in the event of substantial increases in tariffs or restrictions resulting from international trade disputes;
- our customers' development and use of more efficient manufacturing processes and material processing protocols that result in the more efficient utilization of our materials, and therefore reduce their requirements for our materials;
- the comparative advantages and disadvantages of our OLED technologies and materials versus competing technologies and materials currently in the market;
- the nature and potential advantages of any competing technologies that may be developed in the future;
- the outcomes of our ongoing and future research and development activities, and those of others, relating to OLED technologies and materials;
- our ability to acquire and supply OLED materials at cost competitive pricing;
- our ability to compete against third parties with resources greater than ours;
- our ability to respond to and address malicious cybersecurity and IT infrastructure attacks;
- our quarterly cash dividend policy;
- our future OLED technology licensing and OLED material revenues and results of operations, including supply and demand for our OLED materials; and
- general economic and market conditions, including impacts resulting from pandemic outbreaks and regional geopolitical hostilities.

Changes or developments in any of these areas could affect our financial results or results of operations and could cause actual results to differ materially from those contemplated by any forward-looking statements.

All forward-looking statements speak only as of the date of this report or the documents incorporated by reference, as the case may be. We do not undertake any duty to update, correct, modify, or supplement any of these forward-looking statements to reflect events or circumstances after the date of this report or to reflect the occurrence of unanticipated events.

PART I

ITEM 1. *BUSINESS*

Our Company

We are a leader in the research, development and commercialization of organic light emitting diode (OLED) technologies and materials for use in display and solid-state lighting applications. OLEDs are thin, lightweight and power-efficient solid-state devices that emit light that can be manufactured on both flexible and rigid substrates, making them highly suitable for use in full-color displays and as lighting products. OLED displays are capturing a growing share of the display market, especially in the mobile phone, television, wearable, tablet, notebook and personal computer, augmented reality (AR), virtual reality (VR), portable media device and automotive markets. We believe that this is because OLEDs offer potential advantages over competing display technologies with respect to power efficiency, contrast ratio, viewing angle, video response time, form factor and manufacturing cost. We also believe that OLED lighting products have the potential to replace many existing light sources in the future because of their high-power efficiency, excellent color rendering index, low operating temperature and novel form factor. Our technology leadership, our current intellectual property position, and our more than 20 years of experience working closely with leading OLED display manufacturers are some of the competitive advantages that should enable us to continue to share in the revenues from OLED displays and OLED lighting products as they gain wider acceptance.

Our primary business strategy is to (1) develop new OLED materials and sell existing and any new materials to manufacturers of products for display applications, such as mobile phones, televisions, wearables, tablets, portable media devices, notebook computers, personal computers and automotive applications, and specialty and general lighting products; and (2) further develop and license our proprietary OLED technologies to those manufacturers. We have established a significant portfolio of proprietary OLED technologies and materials, primarily through our internal research and development efforts and acquisitions of patents and patent applications, as well as maintaining long-standing, and establishing new relationships with world-class universities, research institutions and strategic manufacturing partnerships. We currently own, exclusively license or have the sole right to sublicense more than 5,000 patents issued and pending worldwide.

We manufacture and sell our proprietary OLED materials to customers for evaluation and use in commercial OLED products. We also enter into agreements with manufacturers of OLED display and lighting products under which we grant them licenses to practice under our patents and to use our proprietary know-how. At the same time, we work with these and other companies that are evaluating our OLED technologies and materials for possible use in commercial OLED display and lighting products.

Market Overview

The Display Panel Market

Thin, energy-efficient display panels that can be manufactured on glass or flexible substrates are essential for a wide variety of portable consumer electronics products, such as mobile phones, AR/VR headsets, digital cameras, wearables, tablets and notebook computers. Due to their narrow profile and light weight, flat panel displays are the display of choice for larger product applications, such as computer monitors and televisions.

Liquid crystal displays, or LCDs, continue to dominate the flat panel display market. However, we believe that OLED displays are an attractive alternative to LCDs, and OLED displays are gaining market share, because they offer a number of potential advantages, including:

- higher power efficiencies, thereby reducing energy consumption;
- a thinner profile and lighter weight;
- higher contrast ratios, leading to sharper picture images and graphics;
- wider viewing angles;
- deposition on non-rigid substrates which enable conformable and flexible displays;
- faster response times for video and gaming; and
- lower cost manufacturing methods and materials.

Based on these characteristics, product manufacturers have adopted small-area OLED displays for use in a wide variety of electronic devices, such as smartphones, wearables and tablets. Manufacturers are increasingly commercializing large-area OLED displays for use in televisions. We believe that if these efforts are successful, they could result in sizeable markets for OLED displays.

Organic materials make technically possible the development of flexible displays for use in an entirely new array of product applications. Such applications include display devices that fold in use, or conform to various shapes for wearable, rollable, industrial and ruggedized applications. In addition, due to the inherent transparency of the organic materials and transparent electrode technologies, OLEDs eventually may enable the production of transparent displays for use in products such as automotive windshields and windows with embedded displays.

The Solid-State Lighting Market

Traditional incandescent light bulbs are inefficient because they convert only about 5% of the energy they consume into visible light, with the rest emerging as heat. Fluorescent lamps use excited gases, or plasmas, to achieve a higher energy conversion efficiency of about 20%. However, the color rendering index of most fluorescent lamps – in other words, the quality of their color compared to an ideal light source – is inferior to that of an incandescent bulb. Fluorescent lamps also pose environmental concerns because they typically contain mercury.

Solid-state lighting relies on the direct conversion of electricity to visible light using semiconductor materials. By avoiding the heat and plasma-producing processes of incandescent bulbs and fluorescent lamps, respectively, solid-state lighting products can have substantially higher energy conversion efficiencies.

There are currently two basic types of solid-state lighting devices: inorganic light emitting diodes, or LEDs, and OLEDs. Current LEDs are very small in size (about one square millimeter) and are extremely bright. Having been developed about 25 years before OLEDs, LEDs are already widely employed in a variety of lighting products, such as traffic lights, digital signage and billboards, replacements for incandescent lighting, backlights for smartphones, computer monitors and televisions, and as border or accent lighting. However, the most commercial LED offerings are characterized by high operating temperatures and intense brightness which may make them less desirable for many lighting applications.

OLEDs, on the other hand, can be designed to provide improved lighting characteristics because they can be larger in size and can be viewed directly, without using diffusers that are required to temper the intense brightness of LEDs. OLEDs can be fabricated onto any suitable surface, including glass, plastic or metal foil, and could be cost-effective to manufacture in high volume. Given these characteristics, product manufacturers are working on and have introduced limited product applications of OLEDs for diffuse specialty lighting applications and ultimately general illumination. If these efforts are successful, we believe that OLED lighting products could begin to be used for applications currently addressed by other existing lighting technologies, as well as for new applications that take advantage of the OLED form factor. In particular, the ability of OLED technology to produce uniform illumination over arbitrary shapes is making OLED lighting very attractive to the automobile industry as well as the digital signage industry.

Our Competitive Strengths

We believe that we currently are one of the leading technology developers in the OLED industry because we were the first company to develop and commercialize PHOLED emitter technology. Our experienced management and research teams have built an extensive intellectual property portfolio around our OLED technologies and materials, particularly with regard to PHOLED emitter materials, which we continually seek to enhance and grow. We work diligently, through the delivery of high-quality commercial products, superior technical support and customer service, to enable our industry-leading customers, which primarily are large display manufacturers, to adopt our OLED technologies and materials through implementation of long-term commercial material supply and patent and know-how license agreements. Our key competitive strengths include:

Technology Leadership

We are a recognized technology leader in the OLED industry. We, along with world-class academic partners Princeton University (Princeton), the University of Southern California (USC), and the University of Michigan (Michigan), pioneered the development of our UniversalPHOLED® phosphorescent OLED technologies, which can be used to produce OLEDs that are up to four times more efficient than fluorescent OLEDs and significantly more efficient than current LCDs, which are illuminated using backlights. We believe that our PHOLED technologies and materials will continue to be well-suited for industry usage in the commercial production of OLED displays and lighting products.

Through our internal, innovative research, which has produced the majority of our most critical commercial technologies, our relationships with supplier companies, such as PPG Industries, Inc. (PPG), and our existing and new academic partners, we believe that we can continue to advance the technology we have already developed and commercialized, and that we will continue to discover and develop other important OLED technologies, as well as novel OLED materials, that will facilitate further adoption of our various OLED technologies by product manufacturers. To this end, we have completed construction of two state-of-the-art laboratories, or Application Centers, near our larger customers in the Asia-Pacific region. We believe these Application Centers will provide us and

our customers with the ability to more quickly evaluate, develop and bring to market our newest OLED materials and technologies. We also are committing significant resources to explore the use of next-generation emissive layer technologies and dry printing technologies such as organic vapor jet printing (OVJP).

Broad Portfolio of Intellectual Property

Generally, each of our commercial offerings is protected by multiple patents which can help us either to prevent or combat the introduction of counterfeit and/or knock-off products that could potentially impact the market demand for our OLED materials and technologies. Our strong patent and non-patented know-how portfolios in the areas of PHOLED emitter materials, complementary PHOLED materials, OLED device designs, and OLED manufacturing technologies are reflective of our continued commitment to innovate and invest. We believe that our extensive portfolio of patents and non-patented know-how provides us with a competitive advantage in the OLED industry.

Through our internal development efforts, acquisitions, and long-standing relationships with academic partners, research institutions and product manufacturers, we own, exclusively license or have the sole right to sublicense more than 5,000 patents issued and pending worldwide. We continue to enhance and grow our OLED technology and materials patent portfolio organically through internal research and development, partnering with third parties, and by acquisition. We also continue to accumulate valuable non-patented technical know-how relating to our OLED technologies and materials.

Leading Supplier of UniversalPHOLED® Emitter Materials and Related Technology Licensing

We are the leading supplier of PHOLED emitter materials to OLED device manufacturers. The emitter material, which is designed to efficiently convert electrical energy to a desired wavelength of light, is the key component in an OLED device. Our manufacturing partner of over 20 years, PPG, continues to manufacture our materials for us, using proprietary manufacturing processes and know-how, which materials we then qualify to our exacting product specifications and resell on a just-in-time basis to OLED device manufacturers. We record revenues based on our sales of these materials to OLED device manufacturers. Our commercial supply agreements typically require our customers to purchase minimum quantities of our materials, which purchases can be in the form of absolute annual minimum purchase obligations or as a minimum percentage of their purchase requirements, or a combination of both.

Our commercial supply arrangements allow us to maintain close technical and business relationships with these OLED device manufacturers purchasing our proprietary materials, and thereby further supports our technology licensing business. We do not directly manufacture or sell OLED display or lighting products. Instead, we enter into non-exclusive licensing arrangements with OLED device manufacturers, many of which also purchase our materials, that pay us fixed license fees and/or running royalties based on their sales of licensed commercial products using our proprietary technology and patents. We believe this business model allows us to concentrate on our core strengths of technology development and innovation, while at the same time provides significant operating leverage. We also believe that this approach may reduce potential competitive conflicts with our customers.

Long-Standing Customer Relationships

We have long-standing customer relationships with OLED device manufacturers that are using, or are evaluating for use, our OLED materials in commercial OLED products. We have more than 20 years of experience in working closely with OLED device manufacturers and have provided support to them in their commercialization of OLED technology by delivering customer-specific solutions for red, green, and yellow emitter materials, or dopants.

We have a proven track record of delivering consistent, high-quality OLED material to our customers. We provide just-in-time supply to our customers and serve as a sole source to them for many of our critical materials. We believe that our unparalleled manufacturing partners, namely PPG, our well-established supply chain, our multi-tier quality testing, and our product assurance protocols make us a preferred partner for our customers and for any large-scale OLED display manufacturer that wants to deliver to high-quality international end-customers.

In 2020, our largest customers for our PHOLED materials included Samsung Display Co., Ltd. (SDC), LG Display Co., Ltd. (LG Display), BOE Technology Group Co., Ltd. (BOE), Tianma Micro-electronics Co., Ltd. (Tianma), Visionox Technology, Inc. (Visionox), Wuhan China Star Optoelectronics Semiconductor Display Technology Co., Ltd. (CSOT), Shenzhen Royale Display Technologies Co. Ltd., Japan Display, Inc., Sharp Corporation, and AU Optronics Corporation (AU Optronics). Other licensed customers of our technology in 2020 included Kaneka Corporation, Pioneer Corporation, and OLEDWorks L.L.C.

Complementary UniversalPHOLED® Host Material Business

In addition to our proprietary UniversalPHOLED® emitter materials, we continue to develop, supply and offer for sale certain of our proprietary phosphorescent host materials to OLED device manufacturers. In addition, we have entered into a number of host material strategic partnerships through development agreements with OLED material partners that are focused on combining our proprietary PHOLED emitters with hosts and other OLED materials of these companies in order to optimize the performance of our emitters in our customers' newest product designs. We do not believe that revenue from our host development and third-party collaboration agreements will be significant compared with our emitter business. However, we believe that development and collaborative relationships such as these are important for ensuring the continued success of the OLED industry and the broader adoption of our PHOLED and other OLED technologies in the marketplace.

Experienced Management and Scientific Advisory Team

Our management team has significant experience in developing business models focused on licensing disruptive technologies in high growth industries. The team has strong relationships with, and deep understandings of, our customers and their needs, the commercial marketplace and the OLED industry on the whole. We believe our management team's experience and long-standing relationships are important to maintaining good and accommodating working relationships with our customers, particularly when we are confronted with challenging technical, regulatory and trade issues given our international reach. In addition, we employ and contract with some of the leading researchers in the industry, and we maintain a long-standing Scientific Advisory Board that includes industry pioneers, namely Professor Stephen R. Forrest of Michigan (formerly of Princeton) and Professor Mark E. Thompson of USC.

Our Business Strategy

Our current business strategy is to continue to promote and expand our portfolio of OLED technologies and materials for widespread use in OLED displays and lighting products. We generate revenues primarily by selling our proprietary OLED materials and licensing our OLED technologies to display and lighting product manufacturers. We are presently focused on the following steps to implement our business strategy:

Expand Our Collaborative Relationships with Leading Product Manufacturers and Developers

We collaborate and partner with leading manufacturers of displays and lighting products who are commercial licensees of our OLED technologies and purchasers of our OLED materials. We also supply our proprietary OLED materials to manufacturers and developers of OLED displays and lighting products for evaluation and for use in product development and for pre-commercial activities, and we provide technical assistance and support to these manufacturers and developers to foster ongoing relationships and new commercial agreements. We concentrate on working closely with OLED device manufacturers and developers because we believe that the successful incorporation of our technologies and materials into commercial products is critical to their widespread adoption.

Enhance Our Existing Portfolio of PHOLED Technologies and Materials

We believe that a strong portfolio of proprietary OLED technologies and materials for both displays and lighting products is critical to our continued success, particularly as the utilization of PHOLED technologies and materials expands in the marketplace. Consequently, we are continually seeking to expand this portfolio through our internal development efforts, our collaborative relationships with existing and new academic and other research partners, and other strategic opportunities, such as funding early-stage startup companies whose technology may be synergistic to ours. Since the acquisition of the early fundamental research developed by our initial academic partners, Princeton and USC, in the late 1990's, one of our primary goals has been and continues to be the development of new and improved PHOLED technologies and materials with increased efficiencies, enhanced color gamut and extended lifetimes, which are compatible with different manufacturing methods, so that they can be used by various manufacturers in a broad array of OLED display and lighting products.

Develop Next-Generation Organic Technologies

We continue to conduct research and development activities relating to next-generation OLED technologies for both displays and lighting products, including next generation emissive layer technologies and dry printing technologies such as OVJP, which we discuss in more detail below. We also are funding research by existing and new academic partners and research institutions on the use of organic thin-film technology in other applications. Our focus on next-generation technologies is designed to enable us to maintain our position as a leading provider of OLED and other organic electronics technologies and materials as new markets emerge.

Business and Geographic Markets

We derive revenue from the following:

- sales of OLED materials for evaluation, development and commercial manufacturing;
- intellectual property and technology licensing;
- technology development and support, including third-party collaboration efforts and providing support to third parties for commercialization of their OLED products; and
- contract research services in the areas of chemical materials synthesis research, development and commercialization for non-OLED applications.

Most manufacturers of displays and lighting products who are or might potentially be interested in our OLED technologies and materials are currently located outside of the United States, particularly in the Asia-Pacific region. To provide on-the-ground support to these manufacturers, we have established wholly-owned subsidiaries in Ireland, Korea, Japan, China and Hong Kong, as well as a representative office in Taiwan. We also have recently completed the construction of new Application Centers in Hong Kong and Seoul, Korea, which we believe will allow our Asia-based display manufacturers to evaluate our technology more quickly and incorporate the technology into their commercial designs. Our wholly-owned subsidiary formed under the laws of the Republic of Ireland, UDC Ireland Ltd. (UDC Ireland), is responsible for all material sales worldwide (excluding the United States) and for licensing and managing intellectual property and undertaking certain other business transactions in all non-U.S. territories.

In 2020, we received a majority of our revenue from three customers domiciled in the Asia-Pacific region, BOE, LG Display and SDC, each of which had revenue in excess of 10% of our consolidated revenue. Our business is heavily dependent on our relationships with these customers. Substantially all revenue derived from our customers is denominated in U.S. dollars.

We generally enter into long-term agreements with our customers, which may include (1) a commercial supply agreement for the purchase of specific OLED materials, and (2) patent and know-how license agreements that relate to the manufacture of display and lighting devices. Generally, our commercial material supply agreements provide for multi-year purchase commitments, typically on a price per gram basis, which entitle our customers to certain discounts, technical support on the use of our OLED materials in mass production facilities, and access to certain future OLED materials. In order to secure preferential pricing and technology access, a customer typically agrees to certain minimum purchase obligations which can be in the form of absolute annual minimum purchase obligations or a percentage of their purchase requirements, or a combination of both. If a customer does not meet its minimum purchase obligations, generally we would have the right to review pricing for future material sales and impose other financial penalties.

Our patent and know-how license agreements generally are made available to our customers for the manufacture of OLED devices. In addition, we also may license to certain material company partners the right to manufacture certain OLED materials that are complementary to our phosphorescent emitter materials. These licenses have included licenses to make host products and certain other non-phosphorescent materials. We believe it is in our, and our customers' best interests to facilitate the development of materials that are complementary to our offerings and which assist our customers to produce more efficient and manufacturable devices with our materials. These collaboration efforts are likely to generate additional licensing fees for us under our license agreements. Although our customers generally pay us fixed license fees and/or running royalties for OLED licensed products that they manufacture, our material partner licensees generally pay us a portion of their sales for materials that are developed under material collaboration agreements and subsequently commercialized. To date, these material collaboration arrangements have not generated significant revenues for us.

For more information on our revenues, costs and expenses associated with our business, as well as a breakdown of revenues from North America and foreign sources, please see our Consolidated Financial Statements and the notes thereto, as well as "Management's Discussion and Analysis of Financial Condition and Results of Operations," included elsewhere in this report.

Our Technology and its Relation to OLED Technology and Structure

OLED devices are solid-state semiconductor devices made from thin films of organic material that emit light of various wavelengths when electricity is selectively applied to the emissive layer of the device. OLED devices are typically referred to as incorporating an "OLED stack." OLED stacks vary in specific structure but those commonly used today may include a cathode, an electron injection layer, an electron transport layer, an emissive layer, a hole transport layer, a hole injection layer and an anode, all of which are placed on a substrate which may be made of a number of different materials, including glass, plastic and metal.

Our technology and materials are most commonly utilized in the emissive layer; the materials in the emissive layer are the light-generating component of the OLED stack. Many of our key technologies relate primarily to phosphorescent emitter materials, which

we believe are more energy efficient than fluorescent emitter materials that can also be used to generate light within the emissive layer of the OLED device. We began selling emitter materials commercially in 2003. A manufacturer will use a small amount of emitter material for each device through a process called "doping" into a host material. The emitter material(s) and the host material(s) together form an emissive layer system. Depending on the nature of the OLED device, the emissive materials and emissive layer system may be designed to emit different colors. We have commercially produced and sold phosphorescent emitter materials that produce red, yellow, green and light-blue light, which are combined in various ways for the display and lighting markets.

Our current materials business, conducted outside the United States by UDC Ireland, is focused primarily on the delivery of such emissive materials. We have also developed host materials for the emissive layer and began selling them commercially in 2011. In addition to our materials, which are generally protected by patents covering various molecular structures, we also have system and process patents that cover various fundamentally important aspects of the OLED device, device architectures, use of materials in devices and OLED manufacturing processes. These patents are important to our licensing business because they enable us to provide our business partners important OLED related technologies.

Our PHOLED Technologies

PHOLED technologies utilize specialized materials and device structures that allow OLEDs to emit light through a process known as phosphorescence. Traditional fluorescent OLEDs emit light through an inherently less efficient process. Theory and experiment show that PHOLEDs exhibit device efficiencies up to four times higher than those exhibited by fluorescent OLEDs. Phosphorescence substantially reduces the power requirements of an OLED and is useful in displays for hand-held devices, such as smartphones, where battery power is often a limiting factor.

Phosphorescence is also important for large-area displays such as televisions, where higher device efficiency and lower heat generation may enable longer product lifetimes and increased energy efficiency.

We have a strong intellectual property portfolio surrounding our existing PHOLED technologies and materials for both displays and lighting products which we market under the UniversalPHOLED® brand. We devote a substantial portion of our efforts to developing new and improved proprietary PHOLED materials and device architectures for red, green, yellow, blue and white OLED devices. In 2020, we continued our commercial supply relationships with companies such as BOE, LG Display, SDC, Tianma, CSOT and Visionox to use our PHOLED materials to manufacture OLED displays. In addition, we have worked and continue to work closely with customers evaluating and qualifying our proprietary PHOLED materials for commercial usage in both displays and lighting products, and with other material suppliers to combine our PHOLED emitters with their phosphorescent hosts and other OLED materials.

Our Additional Proprietary OLED Technologies

Our intellectual property, research, development and commercialization efforts also encompass a number of other OLED device and manufacturing technologies, including, but not limited to, the following:

FOLED ™ Flexible OLEDs

We are working on a number of technologies required for the fabrication of OLEDs on flexible substrates. Most other flat panel displays are built on rigid glass substrates. In contrast, FOLEDs are OLEDs built on non-rigid substrates such as plastic or metal foil. This has the potential to enhance durability and enable conformation to certain shapes or repeated bending or flexing. Many OLED smartphone displays are built on plastic substrates including those produced by SDC and LG Display. Several of our customers demonstrated different foldable and rollable FOLED displays at the 2021 CES (Consumer Electronics Show) in Las Vegas, NV. The commercial introduction of such FOLED product offerings demonstrates the viability of new display product applications, such as portable, roll-up communications televisions, tablets, notebook computers and smartphones, as well as enhance the usefulness of such devices in ruggedized, industrial and wearable computing systems. Manufacturers also may be able to produce FOLEDs using more efficient continuous, or roll-to-roll, processing methods in the future. Our internal research and development efforts are expected to enhance and promote the future adoption of consumer and industrial FOLED devices.

OVJP® Organic Vapor Jet Printing

OLEDs could be manufactured using other processes as well, including OVJP. As a direct printing technique, OVJP technology has the potential to offer high deposition rates for large-area OLEDs. In addition, OVJP technology reduces OLED material waste associated with use of a shadow mask (*i.e.*, the waste of material that deposits on the shadow mask itself when fabricating an OLED). By comparison to inkjet printing, an OVJP process does not use liquid solvents and therefore the OLED materials utilized are not limited by their viscosity or solvent solubility. OVJP also avoids generation of solvent wastes and eliminates the additional step of removing residual solvent from the OLED device. In 2019, we installed a new red-green-blue OVJP pilot tool at our Ewing, New

Jersey facility, and we continue to collaborate on OVJP technology development with Professor Forrest of Michigan. In June 2020, a wholly-owned subsidiary, OVJP Corporation (OVJP Corp), was formed as a Delaware corporation. Based out of California, OVJP Corp was founded to advance the commercialization of our proprietary OVJP technology. We believe the successful implementation of the OVJP technology has the potential to increase the addressable market for large-size OLED panels while also serving another potential growth market for our proprietary PHOLED materials and technologies.

Thin-Film Encapsulation

We have developed proprietary, patented encapsulation technology for the packaging of flexible OLEDs and other thin-film devices, as well as for use as a barrier film for plastic substrates. Addressing a major roadblock to the successful commercialization of flexible OLEDs, our hybrid, multi-layer approach provides barrier performance useful for OLEDs using a potentially cost-effective process. In addition to potentially accelerating the commercial viability of flexible OLEDs, our thin-film encapsulation technology has the potential to provide benefits for a variety of other flexible thin-film devices, including photovoltaics and thin-film batteries.

UniversalP^{2}OLED® Printable Phosphorescent OLEDs

The standard approach for manufacturing a small molecule OLED, including a PHOLED, is based on a vacuum thermal evaporation, or VTE, process. With a VTE process, the thin layers of organic material in an OLED are deposited in a high-vacuum environment. An alternate approach for patterning a small molecule OLED involves solution processing of the various organic materials in an OLED using techniques such as spin coating or inkjet printing onto the substrate. Solution-processing methods, and inkjet printing in particular, have the potential to be scalable to large-area displays.

Our Strategic Relationships with Product Manufacturers

We have established early-stage evaluation programs, development and pre-commercial programs, and commercial arrangements with a substantial number of manufacturers or potential manufacturers of OLED display and lighting products. Many of these relationships are directed towards tailoring our proprietary OLED technologies and materials for use by individual manufacturers. Our ultimate objective is to license our OLED technologies and sell our OLED materials to these manufacturers for their commercial production of OLED products.

Relationships with OLED Display Manufacturers

We license our OLED technologies and patents to display manufacturers for use in commercial products and supply our proprietary OLED materials to these manufacturers for both commercial use and evaluative purposes. We have been collaborating with some of these display manufacturers for nearly 20 years.

We have been working with SDC and providing our PHOLED materials to SDC for evaluation since 2001. Under the terms of a 2011 patent license agreement, we licensed our patents and technologies to SDC for its manufacture and sale of AMOLED display products. Under the terms of a 2011 supplemental purchase agreement, we supplied our proprietary PHOLED materials to SDC for its use in manufacturing licensed products. We also continue to supply SDC with our proprietary UniversalPHOLED materials for use in its development efforts under a 2001 joint development agreement.

The 2011 license and purchase agreements with SDC expired on December 31, 2017, and on February 13, 2018, we entered into new patent license and supplemental purchase agreements, both with an effective date of January 1, 2018. These agreements, which cover the manufacture and sale of specified OLED display materials, last through the end of 2022 with an additional two-year extension option. Under these agreements, we are being paid a license fee, payable in quarterly installments over the agreement term of five years. These agreements convey to SDC the non-exclusive right to make and sell licensed products covered by certain of our intellectual property assets for a limited period of time that is less than the estimated life of the assets. The 2018 supplemental purchase agreement provides for minimum annual purchase obligations of phosphorescent emitter material from us for use in the manufacture of the licensed products. SDC is currently the largest manufacturer of AMOLED displays for smartphones and other personal electronic devices and produces displays for a number of different smartphone and electronic device manufacturers.

We have been working with LG Display and its affiliates for over 15 years. In 2015, we entered into an OLED patent license agreement and an OLED commercial supply agreement with LG Display which were effective as of January 1, 2015 and superseded the existing 2007 commercial supply agreement between the parties. The new agreements have a term that is set to expire by the end of 2022. The patent license agreement provides LG Display a non-exclusive, royalty bearing portfolio license to make and sell OLED displays under our patent portfolio. The patent license calls for license fees, prepaid royalties and running royalties on licensed products. The agreements include customary provisions relating to warranties, indemnities, confidentiality, assignability and business terms. The agreements provide for certain other minimum obligations relating to the volume of material sales anticipated over the life of the agreements as well as minimum royalty revenue to be generated under the patent license agreement. We generate revenue under

these agreements that are predominantly tied to LG Display's sales of OLED licensed products. The OLED commercial supply agreement provides for the sales of materials for use by LG Display, which may include phosphorescent emitters and host materials. LG Display is currently the largest manufacturer of AMOLED displays for large-area televisions and produces display panels for a number of different television manufacturers.

In 2016, we entered into long-term, multi-year OLED patent license and material purchase agreements with Tianma. Under the license agreement, we have granted Tianma non-exclusive license rights under various patents owned or controlled by us to manufacture and sell OLED display products. The license agreement calls for license fees and running royalties on licensed products. Additionally, we supply phosphorescent OLED materials to Tianma for use in its licensed products.

In 2017, we entered into long-term, multi-year agreements with BOE. Under these agreements, we have granted BOE non-exclusive license rights under various patents owned or controlled by us to manufacture and sell OLED display products. We also supply phosphorescent OLED materials to BOE for use in its licensed products.

In 2018, we entered into long-term, multi-year OLED patent license and material purchase agreements with Visionox. Under the license agreement, we have granted Visionox non-exclusive license rights under various patents owned or controlled by us to manufacture and sell OLED display products. The license agreement calls for license fees and running royalties on licensed products. Additionally, we supply phosphorescent OLED materials to Visionox for use in its licensed products.

In 2019, we entered into an evaluation and commercial supply relationship with CSOT. In 2020, we entered into long-term, multi-year agreements with CSOT. Under these agreements, we have granted CSOT non-exclusive license rights under various patents owned or controlled by us to manufacture and sell OLED display products. We also supply phosphorescent OLED materials to CSOT for use in licensed products.

We have been collaborating with AU Optronics since 2001, and we continue to provide our proprietary PHOLED materials to AU Optronics under a 2016 commercial supply agreement through which AU Optronics also has certain license rights.

We also continue to support numerous display manufacturers in their evaluation of our technologies and proprietary OLED materials, through evaluation arrangements in which we provide our proprietary OLED materials to such manufacturers for limited scale commercial production, evaluation and for purposes of development, manufacturing qualification and product testing. Many of these strategic relationships have been in place for longer than a decade, and we continue to establish new relationships.

Relationships with OLED Lighting Manufacturers

We license our OLED technologies and patents to lighting manufacturers for use in commercial products and supply our proprietary OLED materials to these manufacturers for both commercial use and evaluative purposes. Many of these strategic relationships have also been in place for longer than a decade.

Since 2004, we have been supporting Konica Minolta in its efforts to develop OLED lighting products. We continue to license our patents and technology to Konica Minolta under a 2008 OLED technology license agreement for its manufacture and sale of OLED lighting products that utilize our phosphorescent and other OLED technologies. We also continue to provide Konica Minolta with our proprietary PHOLED materials for its manufacture of commercial OLED lighting products under a 2011 commercial material supply agreement, and for evaluation purposes under a 2012 evaluation agreement.

We also continue to license our OLED patents to Sumitomo under a 2015 OLED patent portfolio license agreement in which we granted Sumitomo a non-exclusive, world-wide, royalty bearing license to make and sell OLED lighting panels using a solution-based manufacturing process. Under the license agreement, Sumitomo may also purchase certain of our phosphorescent materials.

We continue to supply LG Display with materials in connection with the OLED lighting business it acquired from LG Chem, Ltd. (LG Chem). This lighting business continues to generate commercial chemical sales and license fee revenues under a limited-term commercial sales agreement we signed with LG Chem prior to its acquisition.

We continue to license our OLED patents, and to provide our OLED materials, to OLEDWorks for use in OLED lighting products under patent license and commercial supply agreements signed in 2015. We have also extended the rights under these agreements to OLEDWorks GmbH, the German company and facility that OLEDWorks acquired in 2015 from Philips Technologie GmbH.

We continue to license our technologies and patents to Kaneka for the manufacture and sale of OLED lighting products, under the terms of a 2013 license agreement, and we continue to supply our materials to Kaneka under a 2014 commercial material supply agreement. We also have a license agreement for the manufacture and sale of OLED lighting products with Pioneer, among others.

Similar to our arrangements with display manufacturers, we continue to support numerous lighting manufacturers in their evaluation of our technologies and proprietary OLED materials, typically through evaluation agreements under which we provide our proprietary OLED materials to such manufacturers for evaluation and potential commercial application.

Relationships with Manufacturers for Other Commercial Products

In addition to our relationships with lighting and display manufacturers, we have agreements and arrangements with manufacturers or potential manufacturers to use our proprietary OLED technologies and materials in other commercial products, such as in automotive interiors and exteriors.

Our OLED Materials Manufacturing Business

We supply our proprietary UniversalPHOLED® materials to display manufacturers, lighting manufacturers and others. These materials are produced in batch quantities by PPG to our exacting product specifications using our manufacturing process and know-how. We qualify each batch of emitters at our device qualification facilities to ensure that they meet required specifications, and we store qualified product inventory for delivery to our customers. We believe that our inventory-carrying practices, along with the terms under which we sell our OLED materials (including payment terms), are typical for the markets in which we operate. In 2018, our OLED materials business received recertification in accordance with ISO 9001:2015 Quality Management Systems. In 2018, UDC's Ewing, NJ facility also received certification in accordance with ISO 14001:2015 Environmental Management Systems.

PPG

We have maintained a close working relationship with PPG since 2000. In 2011, we entered into an agreement with PPG, the term of which continues through December 31, 2021 and is automatically renewed for additional one year terms, unless terminated by us with prior notice of one year or terminated by PPG with prior notice of two years. Under that agreement, PPG is responsible, under our direction, for manufacturing scale-up of our proprietary OLED materials, and for supplying us with those materials. We use these materials for our own research and development as well as for resale to our customers, both for their evaluation and for use in commercial OLED products. Through our collaboration with PPG, key raw materials are sourced from multiple suppliers to ensure that we are able to meet the needs of our customers on a timely basis. We have not had any issues with obtaining access to adequate amounts of any key raw materials.

Collaborations with Other OLED Material Manufacturers

We continued our non-exclusive collaborative relationships with OLED material manufacturing customers during 2020. Most of these relationships are focused on combining our proprietary PHOLED emitters with hosts and other OLED materials of these companies in an effort to optimize our PHOLED emitter products and deliver a high-performance system to the end customer. Our product manufacturing customers are not required to purchase host materials from us. As a result, we do not believe these collaboration efforts will generate significant revenue for us as compared to our emitter and licensing businesses. We believe, however, that collaborative relationships such as these are important for ensuring success of the OLED industry and broader adoption of our PHOLED and other OLED technologies.

Research and Development

Our research and development activities are focused on the advancement of our OLED technologies and materials for displays, lighting and other applications. We conduct this research and development primarily internally and also through various relationships with commercial business partners, academic partners, and research institutions. We also have formed a venture capital company, UDC Ventures LLC, to invest in companies that we believe are developing synergistic or complementary technologies to ours.

Internal Development Efforts

Ewing, New Jersey Facility

We conduct a substantial portion of our OLED development activities at our state-of-the-art development and testing facility in Ewing, New Jersey. At this expanded facility, which now exceeds 50,000 square feet, we perform technology development, including device and process optimization, prototype fabrication, manufacturing scale-up studies, process and product testing, characterization and reliability studies, and technology transfer with our business partners.

Our Ewing facility houses multiple OLED deposition systems, including a full-color flexible OLED system and an OVJP system. In addition, the facility contains equipment for substrate patterning, organic material deposition, display packaging, module assembly and extensive testing in Class 100 and 100,000 clean rooms and opto-electronic test laboratories. Our facility also includes

state-of-the-art synthetic and analytical chemistry laboratories in which we conduct OLED materials research and make small quantities of new materials that we then test in OLED devices.

Application Centers

In addition to our laboratory facilities in Ewing, New Jersey, in 2019 we completed the construction of new, leased, Application Centers in Hong Kong and Seoul, Korea. We believe these centers, which include state-of-the-art OLED laboratories, will better assist our Asia-based customers in their timely evaluation and adoption of our proprietary PHOLED materials, know-how and technologies in their respective PHOLED designs.

Our Contract Research Organization Business: Adesis, Inc.

In 2016, we acquired Adesis, Inc. (Adesis). Adesis is a contract research organization (CRO) that provides support services to the OLED, pharma, biotech, catalysis and other industries. Adesis currently operates in its headquarters facility, which it purchased in 2017 and consists of over 47,500 square feet in New Castle, Delaware and another, leased, 7,000 square foot facility in Wilmington, Delaware. As of December 31, 2020, Adesis employed a team of 100 research scientists, chemists, engineers and laboratory technicians.

Prior to our acquisition of Adesis, we utilized more than 60% of Adesis' technology service and production output. Although we expect to continue to utilize the majority of its technology research capacity for the benefit of our OLED technology development, Adesis is expected to continue operating as a CRO in the above-mentioned industries.

University-Sponsored Research

Princeton, USC and Michigan

We have long-standing relationships with Princeton and USC, dating back to 1994, for the conduct of research relating to our OLED and other organic thin-film technologies and materials for applications such as displays and lighting. This research, which generated many of the original fundamental PHOLED concepts and underlying patents that we commercialized, had been performed at Princeton under the direction of Professor Forrest and at USC under the direction of Professor Thompson. In 2006, Professor Forrest transferred to Michigan, where we continue to fund his research.

In connection with Professor Forrest's transfer to Michigan, in 2006 we entered into a new sponsored research agreement with USC under which we are funding organic electronics research being conducted by Drs. Forrest and Thompson (the 2006 Research Agreement). Work by Professor Forrest is being funded through a subcontract between USC and Michigan. As with the 1997 Research Agreement, we have exclusive license rights to all OLED and thin-film organic electronic patents (other than for organic photovoltaic solar cells) arising out of this research.

The 2006 Research Agreement extends through April 2023 with an option to further extend for an additional two years. We make payments under the 2006 Research Agreement to USC on a quarterly basis as actual expenses are incurred. As of December 31, 2020, we were obligated to pay USC up to $6.9 million for work to be performed during the remaining extended term.

Other Academic Relationships

We entered into a contract research agreement with the Chitose Institute of Science and Technology of Japan (CIST) in 2004. Under that agreement, we funded a research program headed by Professor Chihaya Adachi relating to high-efficiency OLED materials and devices. We were granted exclusive rights to all intellectual property developed under this program. Our relationship with CIST ended in 2006 when Professor Adachi transferred to Kyushu University. However, we have continued our relationship with Professor Adachi under a separate consulting arrangement.

In 2006 and 2007, we entered into one-year research agreements with Kyung Hee University to sponsor research programs on flexible, amorphous silicon thin-film transistor (TFT) backplane technology. The programs were directed by Professor Jin Jang. In 2008 and 2009, we entered into contract research agreements with Silicon Display Technology, Ltd. (SDT), a company founded by Professor Jang, and in 2013, we entered into another one-year agreement with SDT. We continue to maintain a good working relationship with Professor Jang.

Over the years, we have also entered into research agreements with various universities and research institutions that have been able to provide tailored research capabilities and insights relating to our PHOLED technology. As the utilization of PHOLED technology continues to expand, we intend to further engage key researchers at other universities and research institutions to help identify additional fundamental technologies that could benefit PHOLED technology implementation.

U.S. Government-Funded Research

In the past, we have entered into U.S. government contracts and subcontracts to fund a portion of our efforts to develop next-generation OLED technologies concentrated primarily in the area of solid-state lighting. On contracts for which we were the prime contractor, we subcontracted portions of the work to various entities and institutions. All of the U.S. government contracts and subcontracts that we have entered into were subject to termination at the election of the contracting governmental agency. We do not believe that any of these U.S. governmental contracts and subcontracts, or any inventions developed to date under these contracts and subcontracts, are material to our business.

Intellectual Property

Along with our personnel, our primary and most fundamental assets are patents and other intellectual property. This includes more than 5,000 U.S. and foreign patents and patent applications that we own, exclusively license or have the sole right to sublicense. It also includes a substantial body of non-patented technical know-how that we have accumulated over time.

Our Patents

Our research and development activities, conducted both internally and through collaborative programs with third parties, have resulted in our filing of a substantial number of patent applications relating to our OLED technologies and materials. These patents that we own represent, among other things, innovations beyond the original fundamental PHOLED conceptual patents that we license from Princeton, USC and Michigan, described below. Although many of these licensed fundamental conceptual patents have expired or will do so soon, our internal research efforts include essential innovations that have generated commercially viable implementations of the original PHOLED concepts and patents.

As of December 31, 2020, we owned more than 4,900 unexpired issued patents and pending patent applications around the world in addition to the hundreds of patents and patent applications we exclusively license from our research partners, as discussed below.

Patents We License from Research Partners

We exclusively license patent rights from a number of university research partners. Generally, we sponsor scientific researchers at universities to undertake pre-defined research programs, and in exchange we receive license rights to patents that may be developed under the programs. As part of these programs, we may provide compensation in the form of support for research program-related activities, reimbursement for patent related costs, as well as providing for some forms of licensing and/or sublicensing fees for licensed technology that is commercialized by us or our customers. The earliest of our research partners included Princeton, USC, and Michigan, which developed some of the early breakthrough PHOLED technology and related patents in the mid to late 1990's, some of which are now expired. In addition to our continuing work with these universities, we have expanded our sponsored research programs to include additional scientific researchers at other institutions that we believe can provide breakthroughs in promising new fields of research that may benefit the OLED marketplace. As of December 31, 2020, the patent rights we exclusively license from all our university research partners included more than 750 issued patents and pending patent applications in jurisdictions around the world. Under our university patent license agreements, we are generally free to sublicense to third parties all or any portion of the licensed patent rights for the life of the licensed patents, though our rights are subject to termination for an uncured material breach or default by us, or if we become bankrupt or insolvent.

As part of our university license agreements, we may be required to compensate the universities to the extent we, or our sublicensees, utilize the licensed technology. Under the 1997 Amended License Agreement with Princeton we are required to pay Princeton royalties for licensed products sold by us or our sublicensees. These royalties amount to 3% of the net sales price for licensed products sold by us and 3% of the revenues we receive for licensed patents used by our sublicensees. Princeton shares portions of these royalties with USC and Michigan under their inter-institutional agreements. We owed royalties under the 1997 Amended License Agreement with Princeton of $11.1 million for 2020.

Acquired Patents and Other Intellectual Property

From time to time we acquire patents and other intellectual property that we believe provide strategic business opportunities, such as the patent and technology portfolio we acquired from Motorola Solutions, Inc. (f/k/a Motorola, Inc.) (Motorola) in 2011, and the following portfolios from Fujifilm Corporation and BASF:

Patents We Acquired from Fujifilm Corporation

In 2012, we entered into a Patent Sale Agreement (the Fujifilm Agreement) with Fujifilm. Under the Fujifilm Agreement, Fujifilm sold more than 1,200 OLED-related patents and patent applications for a total cost of $109.5 million. The Fujifilm Agreement contains customary representations and warranties and covenants, including respective covenants not to sue by both parties thereto. The Fujifilm Agreement permitted us to assign all of our rights and obligations under the Fujifilm Agreement to our affiliates, and we assigned, prior to the consummation of the transactions contemplated by the Fujifilm Agreement, our rights and obligations to UDC Ireland. The transactions contemplated by the Fujifilm Agreement were consummated on July 26, 2012.

Patents We Acquired from BASF

In 2016, UDC Ireland entered into an IP Transfer Agreement (the BASF Agreement) with BASF. Under the BASF Agreement, BASF sold us more than 500 OLED-related patents and patent applications for a total cost of $96.0 million. The transactions contemplated by the BASF Agreement were consummated on June 28, 2016.

Intellectual Property Developed under Our Government Contracts

We and our subcontractors have developed, and may continue to develop, patentable OLED technology inventions under our various U.S. government contracts and subcontracts, primarily in the area of solid-state lighting. Under these arrangements, we or our subcontractors generally can elect to take title to any patents on these inventions, and to control the manner in which these patents are licensed to third parties. However, the U.S. government reserves rights to these inventions and associated technical data that could restrict our ability to market them to the government for military and other applications, or to third parties for commercial applications. In addition, if the U.S. government determines that we or our subcontractors have not taken effective steps to achieve practical application of these inventions in any field of use in a reasonable time, the government may require that we or our subcontractors license these inventions to third parties in that field of use. We do not believe that our current U.S. governmental contracts and subcontracts, or any inventions developed to date under these contracts and subcontracts, are material to our business.

Non-patented Technical Know-How

We have accumulated, and continue to accumulate, a substantial amount of non-patented technical know-how relating to OLED technologies and materials. Where practicable, we share portions of this information with display manufacturers and other business partners on a confidential basis. We also employ various methods to protect this information from unauthorized use or disclosure, although no such methods can afford complete protection. Moreover, because we derive some of this information and know-how from academic institutions, there is an increased potential for public disclosure. We also cannot prevent the actual independent development of the same or similar information and know-how by third parties.

Competition

The industry in which we operate is highly competitive. We compete against alternative display technologies, in particular LCDs, as well as other OLED technologies. We also compete in the lighting market against incumbent technologies, such as incandescent and fluorescent bulbs, and inorganic LEDs, and against emerging technologies, such as other OLED technologies.

Display Panel Industry Competitors

Numerous domestic and foreign companies have developed or are developing and improving LCD, which includes quantum dot LCDs (which are sometimes referred to as QLEDs), and other display technologies that compete with our OLED display technologies. We believe that OLED display technologies can compete with LCDs, QLEDs and other display technologies for many product applications on the basis of lower power consumption, better contrast ratios, faster video rates, form factor and lower manufacturing cost. However, other companies may succeed in continuing to improve these competing display technologies, or in developing new display technologies, that are superior to OLED display technologies in various respects. We cannot predict the timing or extent to which such improvements or developments may occur.

Lighting Industry Competitors

Although there has been a movement to phase out traditional incandescent bulbs throughout many countries, traditional incandescent bulbs and fluorescent lamps remain well-entrenched products in the lighting industry. In addition, compact fluorescent lamps and solid-state LEDs have been introduced into the market and would compete with OLED lighting products. LEDs have realized significant market adoption in the general lighting market. Having attributes different from fluorescent lamps and LEDs, OLEDs may compete directly with these products for certain lighting applications. However, manufacturers of LEDs and compact

fluorescent lamps may succeed in more broadly adapting their products to various lighting applications, or others may develop competing solid-state lighting technologies that are superior to OLEDs. Again, we cannot predict whether or when this might occur.

OLED Technologies and Materials Competitors

Eastman Kodak Company (Kodak) developed and patented the original fluorescent OLED technology in 1987. Cambridge Display Technology, Ltd. (CDT), which was acquired by Sumitomo Chemical Company in 2007, developed and patented polymer OLED technology in 1989. Display and lighting manufacturers, including customers of ours, are engaged in their own OLED research, development and commercialization activities, and have developed and may continue to develop proprietary OLED technologies that are necessary or useful for commercial OLED devices. In addition, other material manufacturers, such as Sumitomo, Idemitsu Kosan Co., Ltd. (Idemitsu Kosan), Merck KGaA, Cynora Gmbh and Kyulux Inc., are selling or sampling competing OLED materials to customers, including companies to which we sell our proprietary PHOLED materials.

Our licensing business is based on our control of a broad portfolio of OLED-related device patents and technologies. We believe this portfolio includes fundamental patents in the field of phosphorescent OLED materials and devices, as well as certain additional complementary OLED technologies. As discussed above, alternative technologies, such as fluorescent OLED emitter materials, exist and could be competitive to our phosphorescent OLED material solutions. However, fluorescent materials have characteristics that we believe many market participants consider less desirable than those of phosphorescent materials. Suppliers of fluorescent emitter materials include Doosan Solus, Dow Chemical (previously Gracel Display), Idemitsu Kosan and SFC Co. Ltd. Fluorescent materials may also be viewed as complementary in that they can be used in the same OLED stack as phosphorescent materials.

The competitive landscape with respect to our host materials business is characterized by a larger number of established chemical material suppliers who have long-term relationships with many of our existing customers and licensees. We have elected to partner with certain of these companies to manufacture and deliver host solutions to our customers, as well as selling our host materials directly to device manufacturers. We believe our competitive advantage stems, in part, from our deep knowledge of our phosphorescent emitter materials, which are complementary with the host solutions. We believe that our understanding of phosphorescent emitter materials enables us to create host material solutions that are especially well suited for use with a certain class of emitter materials that are implemented commercially today. However, we note that many of our technology partners have their own host solutions and the competitive landscape includes many well-established companies such as Solus, Advanced Materials Co., Dow Chemical, Duksan Neolux Co., Ltd., Idemitsu Kosan, Merck KGaA, NSCC and Samsung SDI Co. Ltd. These companies have significant resources, and some may aggressively pursue such business in the future.

Our existing business relationships with SDC and other product manufacturers suggest that our OLED technologies and materials, particularly our PHOLED technologies and materials, may achieve a significant level of market penetration in the display and lighting industries. However, others, such as those working to develop thermally activated delayed fluorescence (TADF) and micro-LED alternative technologies, may succeed in developing new OLED technologies, materials and alternative solutions that may supplement or be utilized in place of ours. We cannot be sure of the extent to which product manufacturers will adopt and continue to utilize our OLED technologies and materials for the production of commercial displays and lighting products.

Our Venture Capital Business: UDC Ventures LLC

We formed a wholly-owned subsidiary, UDC Ventures LLC, in March 2019, as a corporate venture capital entity that funds companies we believe are developing innovative products and technologies that may be synergistic or complementary to our business and/or business strategies or which may otherwise provide favorable investment opportunities.

Human Capital

As of December 31, 2020, we had 349 active full-time employees and one part-time employee, none of whom are unionized. Of these employees, 242 are research scientists, engineers and laboratory technicians at our domestic and international facilities. This team includes chemists, physicists, engineers and technicians with physics, electrical engineering, mechanical engineering and organic/inorganic chemistry backgrounds, and highly-trained theoreticians and experimentalists. We believe that relations with our employees are good.

The COVID-19 pandemic continues to impact lives and businesses around the world. We have taken proactive steps to help protect the health and safety of our employees and maintain business continuity. A significant majority of our office workers continue to telecommute. Within our production and office areas we have established a number of safety protocols, including face covering and physical distance requirements, enhanced cleaning, encouraging daily self-health checks, and mandatory temperature screening stations managed by health professionals. We have also implemented a coronavirus testing protocol in certain of our offices where the incidence of COVID outbreaks may impact critical operations. As part of that reporting process, we have developed a robust contact tracing program to identify employees who were in close contact with any ill employee in the workplace. All of the actions above are

overseen by a Crisis Management Working Group, a multi-functional, multi-discipline team tasked with integrating all aspects of our COVID-19 response.

Our goal is to be a diverse and inclusive company. Guided by our values, we are committed to creating a company where everyone is included and respected, and where we support each other in reaching our full potential. We are committed to diverse representation across all levels of our workforce to reflect the vibrant and thriving diversity of the communities in which we live and work. Women represent 33% of our executive management team, 23% of our leadership (Director level and above) and 24% of our total workforce, as well as 33% of our Board of Directors. We have employees from over 25 countries in our workforce, and we believe that a diverse workforce made up of people with different ideas, strengths, interests and cultural backgrounds drives employee and business success. In 2020 our voluntary turnover rate was 5%, and we had overall employee growth rate of 13%. Additional data, including historical turnover and diversity information, as well as our corporate policies relating to our employee engagement and human capital, are updated on our website www.oled.com, and included in our annual Corporate Responsibility Report.

Our Company History

Our corporation was organized under the laws of the Commonwealth of Pennsylvania in 1985. Our business was commenced in 1994 by a company then known as Universal Display Corporation, which had been incorporated under the laws of the State of New Jersey. In 1995, a wholly-owned subsidiary of ours merged into this New Jersey corporation. The surviving corporation in this merger became a wholly-owned subsidiary of ours and changed its name to UDC, Inc. Simultaneously with the consummation of this merger, we changed our name to Universal Display Corporation. UDC, Inc. functions as an operating subsidiary of ours and has certain overlapping officers and directors. We have also formed or acquired other wholly-owned subsidiaries, including Universal Display Corporation Hong Kong, Limited (2008), Universal Display Corporation Korea, Y.H. (2010), Universal Display Corporation Japan GK (2011), UDC Ireland Ltd. (2012), Universal Display Corporation China, Ltd. (2016), Adesis, Inc. (2016), UDC Ventures LLC (2019), and OVJP Corporation (2020), and we established a representative office in Taiwan (2011).

Our Compliance with Environmental Protection Laws

We are not aware of any material effects that compliance with Federal, State or local environmental protection laws or regulations will have on our business. We have not incurred substantial costs to comply with any environmental protection laws or regulations, and we do not anticipate having to do so in the foreseeable future.

Our Internet Site

Our Internet address is www.oled.com. We make available through our Internet website, free of charge, our annual reports on Form 10-K, quarterly reports on Form 10-Q, current reports on Form 8-K and amendments to those reports filed or furnished pursuant to Section 13(a) or 15(d) of the Securities Exchange Act of 1934 as soon as reasonably practicable after we file such material with the Securities and Exchange Commission (the SEC). The SEC maintains a website that contains these reports as well as proxy statements and information regarding issuers who file electronically, with the address www.sec.gov. In addition, we have made available on our Internet website under the heading “Corporate Governance” the charter for the Audit Committee of our Board of Directors, the charter for the Compensation Committee of our Board of Directors, the charter for the Nominating & Corporate Governance Committee of our Board of Directors, our Code of Ethics & Business Conduct for Employees, our Code of Conduct for Directors, and our Corporate Governance Guidelines. We intend to make available on our website any future amendments or waivers to our Code of Ethics & Business Conduct for Employees and our Code of Conduct for Directors. The information on our Internet site is not part of this report.

INFORMATION ABOUT OUR EXECUTIVE OFFICERS

The following table sets forth certain information with respect to our executive officers as of February 18, 2021:

Name	Age	Position
Sherwin I. Seligsohn	85	Founder and Chairman of the Board of Directors
Steven V. Abramson	69	President, Chief Executive Officer and Director
Sidney D. Rosenblatt	73	Executive Vice President, Chief Financial Officer, Treasurer, Secretary and Director
Julia J. Brown	59	Senior Vice President and Chief Technical Officer
Janice K. Mahon	63	Vice President of Technology Commercialization and General Manager, PHOLED Material Sales Business
Mauro Premutico	55	Vice President, Legal and General Manager, Patents and Licensing

Our Board of Directors has appointed these executive officers to hold office until their successors are duly appointed.

Sherwin I. Seligsohn is our Founder and has been the Chairman of our Board of Directors since June 1995. He also served as our Chief Executive Officer from June 1995 through December 2007, and as our President from June 1995 through May 1996. Mr. Seligsohn serves as the Director and the President and Secretary of American Biomimetics Corporation, International Multi-Media Corporation, and Wireless Unified Network Systems Corporation. He was also previously the Chairman of the Board of Directors, President and Chief Executive Officer of NanoFlex Power Corporation (formally known as Global Photonic Energy Corporation) (NanoFlex) until April 2012, when he resigned from his positions at NanoFlex. Since that time, Mr. Seligsohn's only relationship with NanoFlex is as a shareholder and option holder. From June 1990 to October 1991, Mr. Seligsohn was Chairman Emeritus of InterDigital Communications, Inc. (InterDigital), formerly International Mobile Machines Corporation. He founded InterDigital and from August 1972 to June 1990 served as its Chairman of the Board of Directors. Mr. Seligsohn is a member of the Industrial Advisory Board of the Princeton Institute for the Science and Technology of Materials (PRISM) at Princeton University.

Steven V. Abramson is our President and Chief Executive Officer, and has been a member of our Board of Directors since May 1996. Mr. Abramson served as our President and Chief Operating Officer from May 1996 through December 2007. From March 1992 to May 1996, Mr. Abramson was Vice President, General Counsel, Secretary and Treasurer of Roy F. Weston, Inc., a worldwide environmental consulting and engineering firm. From December 1982 to December 1991, Mr. Abramson held various positions at InterDigital, including General Counsel, Executive Vice President and General Manager of the Technology Licensing Division.

Sidney D. Rosenblatt is an Executive Vice President and has been our Chief Financial Officer, Treasurer and Secretary since June 1995. He also has been a member of our Board of Directors since May 1996. Mr. Rosenblatt was the owner of S. Zitner Company from August 1990 through August 2010 and served as its President from August 1990 through December 1998. From May 1982 to August 1990, Mr. Rosenblatt served as the Senior Vice President, Chief Financial Officer and Treasurer of InterDigital. Mr. Rosenblatt is on the Board of Managers of the Overbrook School for the Blind.

Julia J. Brown, Ph.D. is a Senior Vice President and has been our Chief Technical Officer since June 2002. She joined us in June 1998 as our Vice President of Technology Development. From 1991 to 1998, Dr. Brown was a Research Department Manager at Hughes Research Laboratories where she directed the pilot line production of high-speed Indium Phosphide-based integrated circuits for insertion into advanced airborne radar and satellite communication systems. Dr. Brown received an M.S. and Ph.D. in Electrical Engineering/Electrophysics at USC and a B.S.E.E. from Cornell University. Dr. Brown is an elected Fellow of both the IEEE and the Society of Information Display (SID).

Janice K. Mahon has been our Vice President of Technology Commercialization since January 1997, and became the General Manager of our PHOLED Material Sales Business in January 2007. From 1992 to 1996, Ms. Mahon was Vice President of SAGE Electrochromics, Inc., a thin-film electrochromic technology company, where she oversaw a variety of business development, marketing and finance and administrative activities. From 1984 to 1989, Ms. Mahon was a Vice President and General Manager for Chronar Corporation, a leading developer and manufacturer of amorphous silicon photovoltaic (PV) panels. Prior to that, Ms. Mahon worked as Senior Engineer for the Industrial Chemicals Division of FMC Corporation. Ms. Mahon received her B.S. in Chemical Engineering from Rensselaer Polytechnic Institute in 1979, and an M.B.A. from Harvard University in 1984. Ms. Mahon was a member of the Technical Council of the FlexTech Alliance from 1997 through 2010, and a member of its Governing Board from 2008 through 2010. Ms. Mahon was a member of the Board of Directors and Marketing Committee Chairperson of the OLED Association from 2009-2014.

Mauro Premutico has been our Vice President of Legal and General Manager of Patents and Licensing since April 2012. Prior to joining us, Mr. Premutico was the Managing Vice President and Chief Patent Counsel for The Walt Disney Company from 2009 to 2012, and Vice President of Intellectual Property and Associate General Counsel for Lenovo Group Ltd. from 2005 to 2009. Mr. Premutico was also Special Counsel at the law firm of Cleary, Gottlieb, Steen & Hamilton from 2002 until 2005 where he served as the co-head of the New York office's Intellectual Property and Technology Law practice. Mr. Premutico received a J.D. from Boston University School of Law, an M.B.A. from Yale University and a B.S.E.E. from Worcester Polytechnic Institute.

ITEM 1A. *RISK FACTORS*

You should carefully consider the following risks and uncertainties when reading this Annual Report on Form 10-K. The following factors, as well as other factors affecting our operating results and financial condition, could cause our actual future results and financial condition to differ materially from those projected.

Risks Related to Our Intellectual Property

If we cannot obtain and maintain appropriate patent and other intellectual property protection for our OLED technologies and materials, our business will suffer.

The value of our OLED technologies and materials is dependent on our ability to secure and maintain appropriate patent and other intellectual property rights protection. Although we own or license many patents respecting our OLED technologies and materials that have already been issued, there can be no assurance that additional patents applied for will be obtained, or that any of these patents, once issued, will afford commercially significant protection for our OLED technologies and materials, or will be found valid if challenged. Also, there is no assurance that we will be successful in defending the validity of our current or future patents in pending and future patent oppositions, invalidation trials, interferences, reexaminations, reissues, or other administrative or court proceedings. Moreover, we have not obtained patent protection for some of our OLED technologies and materials in all foreign countries in which OLED products or materials might be manufactured or sold.

We believe that the strength of our current intellectual property position results primarily from the essential nature of our fundamental patents covering phosphorescent OLED devices and certain materials utilized in these devices. Certain of our existing fundamental phosphorescent OLED patents expired in the United States in 2017 and 2019; and expired in other countries of the world in 2018 and 2020. While we hold a wide range of additional patents and patent applications relating to our commercial OLED materials and technologies whose expiration dates extend (and in the case of patent applications, will extend) beyond 2020, many of which are also of importance in the OLED industry, none may be of an equally essential nature as our original fundamental patents, and therefore our competitive position may be less certain as a result of the expiration of these patents.

We have more than 5,000 issued and pending patents relating to our OLED technologies. There is no assurance that these patents and applications will not be challenged prior to their respective expirations in any of the jurisdictions in which they are utilized, or that if challenged, we will be able to secure sufficient breadth of protection, and monetary and injunctive relief for the violation of our rights to make up for the business harm resulting from such activities. Moreover, there can be no assurance that competitors will not develop or produce competing PHOLED material designs that may be outside of our existing patents. There may also be fundamental new advancements in the field of OLED technology that could enable the commercial use of older and unpatented PHOLED materials or the adoption of new OLED materials that do not require the utilization of our proprietary PHOLED materials to achieve superior performance characteristics.

We may become engaged in litigation to protect or enforce our patent and other intellectual property rights, or in International Trade Commission proceedings to abate the importation of goods that would compete unfairly with those of our licensees. In addition, we are participating in or have participated in, and in the future will likely have to participate in, interference, reissue, or reexamination proceedings before the U.S. Patent and Trademark Office, and opposition, nullity or other proceedings before foreign patent offices, with respect to some of our patents or patent applications. All of these actions place our patents and other intellectual property rights at risk and may result in substantial costs to us as well as a diversion of management attention from our business and operations. Moreover, if successful, these actions could result in the loss of patent or other intellectual property rights protection for the key OLED technologies and materials on which our business depends.

We rely, in part, on several non-patented proprietary technologies to operate our business. Others may independently develop the same or similar technologies or otherwise obtain access to our unpatented technologies. Furthermore, these parties may obtain patent protection for such technology, inhibiting or preventing us from practicing the technology. To protect our trade secrets, know-how and other non-patented proprietary information, we require employees, consultants, financial advisors and strategic partners to enter into confidentiality agreements. These agreements may not ultimately provide meaningful protection for our trade secrets, know-how or other non-patented proprietary information. In particular, we may not be able to fully or adequately protect our proprietary information as we conduct discussions with potential strategic partners.

Additionally, although we take many measures and implement safeguards to prevent unauthorized use, including by theft and misuse, of our intellectual property and proprietary information, third parties may attempt to obtain, copy, reverse-engineer, use or disclose, illegally or otherwise, such intellectual property and proprietary information. We also may face attempts by others to gain unauthorized access through the Internet to our information technology systems or to our intellectual property, which might be the result of industrial or other espionage or actions by hackers seeking to harm our company or its products. If we are unable to protect the proprietary nature of our intellectual property and proprietary information, it will harm our business.

We or our customers may incur substantial costs or lose important rights as a result of litigation or other proceedings relating to our patent and other intellectual property rights or with respect to our OLED materials business.

There are a number of other companies and organizations that have been issued patents and are filing patent applications relating to OLED technologies and materials, including, without limitation, Kodak (substantially all of whose OLED assets were sold to a group of LG companies in 2009), CDT (acquired by Sumitomo in 2007), Canon, Inc., Semiconductor Energy Laboratories Co., Idemitsu Kosan and Mitsubishi Chemical Corporation. In addition, some of our customers such as SDC and LG Display have been issued patents and are filing patent applications relating to OLED technologies and materials. As a result, there may be issued patents or pending patent applications of third parties that would be infringed by the use of our OLED technologies or materials, thus subjecting our customers to possible suits for patent infringement in the future. Such lawsuits could result in our customers being liable for damages or require our customers to obtain additional licenses that could increase the cost of their products. This, in turn, could have an adverse effect on our customers' sales and thus our royalties or material sales revenues, or cause our customers to seek to renegotiate our royalty rates or pricing. In addition, we have agreed to indemnify customers purchasing our OLED materials for commercial usage against certain claims of patent infringement by third parties, as a result of which we may incur substantial legal costs in connection with defending these customers from such claims.

Our licensees may also seek to avoid paying future royalties by attempting to have our patents declared invalid and unenforceable by a court. Our licensees may be more likely to file such declaratory actions in light of the U.S. Supreme Court's decision in *MedImmune, Inc. v. Genentech, Inc*. (2007), in which the Court found that a licensee need not refuse to pay royalties and commit material breach of the license agreement before bringing an action to declare a licensed U. S. patent invalid and unenforceable.

In addition, we may be required, from time-to-time, to assert our intellectual property rights by instituting legal proceedings against others. We cannot be assured that we will be successful in enforcing our patents in any lawsuits we may commence. Defendants in any litigation we may commence to enforce our patents may attempt to establish that our patents are invalid or are unenforceable. Thus, any patent litigation we commence could lead to a determination that one or more of our patents are invalid or unenforceable. If a third party succeeds in invalidating one or more of our patents, that party and others could compete more effectively against us. Our ability to derive licensing revenues from products or technologies covered by these patents would also be adversely affected.

Whether our customers are defending the assertion of third-party intellectual property rights against their businesses arising as a result of the use of our technology, or we are asserting our own intellectual property rights against others, such litigation can be complex, costly, protracted and highly disruptive to our or our customers' business operations by diverting the attention and energies of management and key technical personnel. As a result, the pendency or adverse outcome of any intellectual property litigation to which we or our customers are subject could disrupt business operations, require the incurrence of substantial costs and subject us or our customers to significant liabilities, each of which could severely harm our business. Costs associated with these actions are likely to increase as AMOLED products using our PHOLED and other OLED technologies and materials continue to enter the consumer marketplace.

Plaintiffs in intellectual property cases often seek injunctive relief in addition to money damages. Any intellectual property litigation commenced against our customers may force them to take actions that could be harmful to their businesses and thus to revenues, including the halting of sales of products that incorporate or otherwise use our technology or materials.

Furthermore, the measure of damages in intellectual property litigation can be complex and is often subjective or uncertain. If our customers were to be found liable for infringement of proprietary rights of a third party, the amount of damages they might have to pay could be substantial and is difficult to predict. Decreased sales of our customers' products incorporating our technology or materials would have an adverse effect on our royalty revenues under existing licenses and material sales under our existing sales agreements. Were this to occur, it would likely harm our ability to (i) obtain new licensees which would have an adverse effect on the terms of the royalty arrangements we could enter into with any new licensees, and (ii) sell our UniversalPHOLED® materials to existing and new customers. Moreover, to the extent any third party claims are directed specifically to materials supplied by us to our customers, we may be required to incur significant costs associated with the defense of such claims and potential damages associated with such claims that may be awarded against our customers.

As is commonplace in technology companies, we employ individuals who were previously employed at other technology companies. To the extent our employees are involved in research areas that are similar to those areas in which they were involved at their former employers, we may be subject to claims that such employees or we have, inadvertently or otherwise, used or disclosed the alleged trade secrets or other proprietary information of the former employers. Litigation may be necessary to defend against such claims. The costs associated with these actions or the loss of rights critical to our or our customers' businesses could negatively impact our revenues or cause our business to fail.

Recent court decisions in various patent cases may make it more difficult for us to obtain future patents, enforce our patents against third parties or obtain favorable judgments in cases where the patents are enforced.

Recent case law may make it more difficult for patent holders to secure future patents and/or enforce existing patents. For example, in *KSR International Co. vs. Teleflex, Inc*. (2007), the U.S. Supreme Court mandated a more expansive and flexible approach to determine whether a patent is obvious and invalid. As a result of the less rigid approach to assessing obviousness, defending the validity of or obtaining patents may be more difficult.

Recent court decisions may also impact the enforcement of our patents. For example, we may not be able to enjoin certain third party uses of products or methods covered by our patents following the initial authorized sale, even where those uses are expressly proscribed in an agreement with the buyer. Also, we may face increased difficulty enjoining infringement of our patents. The U.S. Supreme Court has held that an injunction should not automatically issue based on a finding of patent infringement, but should be determined based on a test balancing considerations of the patentee's interest, the infringer's interest, and the public's interest. Obtaining enhanced damages for willful infringement of our patents may also be more difficult even in those cases where we successfully prove a third party has infringed our patents, as a recent case set a more stringent standard for proving willful infringement.

Therefore, as a result of such rulings, it may be more difficult for us to defend our currently issued patents, obtain additional patents in the future or achieve the desired competitive effect even when our patents are enforced. If we are unable to so defend our currently issued patents, or to obtain new patents for any reason, our business would suffer.

Risks Related to Our Business and Operations

If we cannot form and maintain lasting business relationships with OLED product manufacturers, our business strategy will fail.

Our business strategy ultimately depends upon our development and maintenance of commercial licensing and material supply relationships with high-volume manufacturers of OLED products. We have entered into a limited number of such relationships from which most of our material sales and licensing revenue are generated. Our other relationships with product manufacturers currently are limited to technology development and the evaluation of our OLED technologies and materials for possible use in commercial products. Some or all of these relationships may not succeed or, even if they are successful, may not result in the product manufacturers entering into commercial licensing and material supply relationships with us.

Many of our agreements with product manufacturers last for only limited periods of time, such that our relationships with these manufacturers will expire unless they are renewed. These product manufacturers may not agree to renew their relationships with us on a continuing basis or may agree to do so on terms that are less favorable to us. In addition, we regularly continue working with product manufacturers after our existing agreements with them have expired while we are attempting to negotiate contract extensions or new agreements with them. Should our relationships with the various product manufacturers not continue or be renewed on less favorable terms, or if we are not able to identify other product manufacturers and enter into contracts with them, our business may materially suffer.

Our ability to enter into additional commercial licensing and material supply relationships, or to maintain our existing relationships, may depend on our ability to make certain financial or other commitments. We might not be able, for financial or other reasons, to enter into or continue these relationships on commercially acceptable terms, or at all. Failure to do so may cause our business strategy to fail.

If we fail to continue to make advances in our OLED research and development activities, we might not succeed in continuing to commercialize our OLED technologies and materials.

Further advances in our OLED technologies and materials depend, in part, on the success of the research and development work we conduct, both alone and with our research partners. We cannot be certain that this work will yield additional advances in the research and development of these technologies and materials.

Our research and development efforts remain subject to all of the risks associated with the development of new products based on emerging and innovative technologies, including, without limitation, unanticipated technical or other problems and the possible insufficiency of funds for completing development of these products. Technical problems may result in delays and cause us to incur additional expenses that would increase our losses. If we cannot complete research and development of our OLED technologies and materials successfully, or if we experience delays in completing research and development of our OLED technologies and materials for use in potential commercial applications, particularly after incurring significant expenditures, our business may fail.

Conflicts or other problems may arise with our customers or joint development partners, resulting in renegotiation, breach or termination of, or litigation related to, our agreements with them. This would adversely affect our revenues.

Conflicts or other problems could arise between us and our customers or joint development partners, some of which we have made strategic investments in, as to royalty rates, milestone payments or other commercial terms. Similarly, we may disagree with our customers or joint development partners as to which party owns or has the right to commercialize intellectual property that is developed during the course of the relationship or as to other non-commercial terms. If such a conflict were to arise, a customer or joint development partner might attempt to compel renegotiation of certain terms of their agreement or terminate their agreement entirely, and we might lose the royalty revenues, material sales revenues and other benefits of the agreement. Either we or the customer or joint development partner might initiate litigation to determine commercial obligations, establish intellectual property rights or resolve other disputes under the agreement. Such litigation could be costly to us and require substantial attention of management. If we were unsuccessful in such litigation, we could lose the commercial benefits of the agreement, be liable for financial damages and suffer losses of intellectual property or other rights that are the subject of dispute.

If our OLED technologies and materials are not feasible for broad-based product applications, we may not be able to continue to generate revenues sufficient to support ongoing operations.

Our main business strategy is to sell our OLED materials and license our OLED technologies to manufacturers for incorporation into the display and lighting products that they sell. Consequently, our success depends on the ability and willingness of manufacturers to continue to develop, manufacture and sell commercial products integrating our technologies and materials.

Before product manufacturers will agree to expand the use of our OLED technologies and materials for wider scale commercial production, they will likely require us to demonstrate to their satisfaction that our OLED technologies and materials are feasible for broad-based product applications beyond current commercial application, such as smartphones, wearables and television displays. This, in turn, may require additional advances in our technologies and materials, as well as those of others, for applications in a number of areas, including, without limitation, advances with respect to the development of:

- OLED materials with improved lifetimes, efficiencies and color coordinates for larger area full-color OLED displays and general lighting products;
- more robust OLED materials for use in more demanding large-scale manufacturing environments; and
- scalable and cost-effective methods and technologies for the fabrication of large volume OLED materials and products.

We cannot be certain that these advances will occur, and hence our OLED technologies and materials may not be feasible for additional broad-based product applications and expansion.

Even if our OLED materials and technologies are technically feasible, they may not be further adopted by product manufacturers for broad-based product applications.

The potential size, timing and viability of market opportunities targeted by us remain uncertain. Market acceptance of our OLED materials and technologies beyond current product offerings and sales volumes will depend, in part, upon these materials and technologies providing benefits comparable or superior to competing display and lighting technologies at an advantageous cost to manufacturers, and the adoption of products incorporating these technologies by consumers. Many current and potential customers for our OLED technologies utilize and have invested significant resources in competing technologies, and may, therefore, be reluctant to redesign their products or manufacturing processes to incorporate our OLED technologies.

During the entire product development process for a new product, we face the risk that our materials or technologies will fail to meet the manufacturer's technical, performance or cost requirements or will be replaced by a competing product or alternative technology. Even if we offer materials and technologies that are satisfactory to a product manufacturer, the manufacturer may choose to delay or terminate its product development efforts for reasons unrelated to our materials or technologies. In addition, our agreements with our customers do not require them to purchase our host materials in order to utilize our phosphorescent emitter materials, and those customers may elect not to purchase our host materials.

Mass production of new mass market OLED products will require the availability of suitable manufacturing equipment, components and materials, many of which are available only from a limited number of suppliers. In addition, there may be a number of other technologies that manufacturers need to utilize in conjunction with our OLED technologies in order to bring these new OLED products to the market. Thus, even if our OLED technologies are a viable alternative to competing approaches, if product manufacturers are unable to obtain access to this equipment and these components, materials and other technologies, they may not utilize our OLED technologies.

There are numerous potential alternatives to OLEDs, which may limit our ability to commercialize our OLED technologies and materials.

The display market is currently, and will likely continue to be for some time, dominated by displays based on LCD technology. Numerous companies are making substantial investments in, and conducting research to improve characteristics of, LCDs; additionally, other competing display technologies have been, or are being, developed. A similar situation exists in the solid-state lighting market, which is currently dominated by LED products. Advances in any of these various technologies may overcome their current limitations and permit them to become the leading technologies in their field, either of which could limit the potential market for products utilizing our OLED technologies and materials. This, in turn, would cause product manufacturers to avoid entering into commercial relationships with us, or to terminate or not renew their existing relationships with us.

Other OLED technologies may be more successful or cost-effective than ours, which may limit the commercial adoption of our OLED technologies and materials.

Our competitors have developed and continue to develop OLED technologies that differ from or compete with our OLED technologies. In particular, competing fluorescent and thermally activated delayed fluorescence OLED technology may become a viable alternative to our phosphorescent OLED technology. Moreover, our competitors may succeed in developing new OLED technologies that may become more cost-effective or have fewer limitations than our OLED technologies. If our OLED technologies, and particularly our phosphorescent OLED technology, are unable to continue to capture a substantial portion of the OLED product market, our business strategy may fail.

The consumer electronics industry experiences significant downturns from time to time, any of which may adversely affect the demand for and pricing of our OLED technologies and materials.

Our success depends upon the ability and continuing willingness of our customers to manufacture and sell products utilizing our technologies and materials, specifically our phosphorescent emitters and host materials, and the widespread acceptance of our customers' products in the consumer marketplace. Any slowdown in the demand for our customers' products or a decrease in our customers' use of or demand for our materials would adversely affect our material sales and royalty revenues and thus our business. Our customers' decrease in the use of or demand for our materials may depend on several factors, including pricing, availability, continued technical improvements and competitive product offerings. The markets for flat panel displays and lighting products are highly competitive. Success in the market for end-user products that may integrate our OLED technologies and materials also depends on factors beyond the control of our customers and us, including the cyclical and seasonal nature of the end-user markets that our customers serve, as well as industry and general economic conditions.

The markets that we hope to penetrate have experienced significant periodic downturns, often in connection with, or in anticipation of, declines in general economic conditions. These downturns have been characterized by lower product demand, production overcapacity and erosion of average selling prices. Our business strategy is dependent on manufacturers building and selling products that incorporate our OLED technologies and materials. Industry-wide fluctuations and downturns in the demand for displays and solid-state lighting products could cause significant harm to our business.

Our customers may develop new or more efficient manufacturing processes, which may adversely affect demand for our OLED materials.

By developing enhanced material processing methods and more efficient manufacturing techniques, our customers who purchase our phosphorescent emitter and host materials could become more efficient in the utilization of our materials by developing designs that require less materials on a per square meter basis, or by modifying their manufacturing process to make more efficient use of our materials, which could limit or reduce the amount of materials they purchase from us. Thus, demand for our materials may not expand in proportion to the number of OLED related products manufactured by our customers, and may result in reduced demand for our materials and technologies relative to our customers' manufacture and sale of products made with such materials.

The COVID-19 pandemic has had, and we expect it to continue to have, a material adverse effect on our operations and business. Any similar future epidemic or pandemic could also have such an effect.

The COVID-19 pandemic has negatively impacted the global economy, disrupted consumer spending and global supply chains, and created significant volatility and disruption of financial markets. We expect the COVID-19 pandemic to continue to have an adverse impact on our business and financial performance. The extent of the impact of the COVID-19 pandemic on our business and financial performance, including our ability to execute our near-term and long-term business strategies and initiatives in the expected time frame, will depend on future developments, including the duration and severity of the pandemic, which are uncertain and cannot be predicted.

As a result of the COVID-19 pandemic, and in response to government mandates or recommendations, as well as decisions we have made to protect the health and safety of our employees and communities, we have taken proactive measures to adopt social distancing policies at all of our locations, including working from home, reducing the number of people in our sites at any one time, and suspending employee travel. In the future, we may face closure requirements and other operational restrictions with respect to some or all of our physical locations for prolonged periods of time due to, among other factors, evolving and increasingly stringent governmental restrictions including public health directives, quarantine policies or social distancing measures. In addition, many of our customers may reduce their operations, as demand for their products becomes negatively affected, which would adversely impact our revenues from these customers. As a result, we would expect our financial results to be materially adversely impacted.

In addition, consumer spending generally may also be negatively impacted by general macroeconomic conditions and consumer confidence, including the impact of any recession, resulting from the COVID-19 pandemic. This may negatively impact sales for our customers and may also have an impact on their development of new products.

As a result of the COVID-19 pandemic, we have implemented a work from home policy for many of our corporate employees. This policy may negatively impact productivity and cause other disruptions to our business, and have material and adverse effects on our business, financial condition and results of operations.

The extent of the impact of the COVID-19 pandemic on our business is highly uncertain and difficult to predict, as information is rapidly evolving with respect to the duration and severity of the pandemic. At this point, we cannot reasonably estimate the duration and severity of the COVID-19 pandemic, or its overall impact on our business, financial condition and results of operations.

Should there be in the future any similar epidemic or pandemic that harms the global economy in general, our business, financial condition and results of operations could be adversely affected. We may also experience impacts to certain of our customers as a result of health epidemic or other outbreak occurring in one or more locations, which in turn may materially and adversely affect our business, financial condition and results of operations.

Any downturn in U.S. or global economic conditions may have a significant adverse effect on our business.

There have been significant and sustained economic downturns in the U.S. and globally in the past. These downturns have placed pressure on consumer demand, and the resulting impact on consumer spending has had a material adverse effect on the demand for consumer electronic products. Similar downturns in the future may have a significant adverse effect on one or more of our licensees as an enterprise, which could result in those licensees reducing their efforts to commercialize products that incorporate our OLED technologies and materials. Consumer demand and the condition of the display and lighting industries may also be impacted by other external factors such as war, terrorism, geopolitical uncertainties, epidemics and other business interruptions. The impact of these external factors is difficult to predict, and one or more of these factors could adversely impact the demand for our customers' products, and thus our business.

Many of our competitors have greater resources, which may make it difficult for us to compete successfully against them.

The display and solid-state lighting industries are characterized by intense competition. Many of our competitors have better name recognition and greater financial, technical, marketing, personnel and research capabilities than we do. Because of these differences, we may never be able to compete successfully in these markets or maintain any competitive advantages we are able to achieve over time.

If we cannot keep our key employees or hire other talented persons as we grow, our business might not succeed.

Our performance is substantially dependent on the continued services of our executive officers and other key technical and managerial personnel, and on our ability to offer competitive salaries and benefits to these and our other employees. We do not have employment agreements with any of our executive officers or other key technical or managerial personnel that require them to continue to work for us for any specified period and, therefore, they could terminate their employment with us at any time.

Additionally, competition for highly skilled technical and managerial personnel is intense. We might not be able to attract, hire, train, retain and motivate the highly skilled employees we need to be successful. If we fail to attract and retain the necessary technical and managerial personnel, our business will suffer and might fail.

We rely solely on PPG to manufacture the OLED materials we use and sell to product manufacturers.

Our business prospects depend significantly on our ability to obtain proprietary OLED materials for our own use and for sale to product manufacturers. Our agreement with PPG provides us with a source for these materials for development, evaluation and commercial purposes. Our agreement with PPG currently runs through the end of 2021 and shall be automatically renewed for additional one-year terms, unless terminated by us with prior notice of one year or terminated by PPG with prior notice of two years. Our inability to continue obtaining these OLED materials from PPG or another source at cost-competitive prices and to continue obtaining these OLED materials in sufficient quantities to meet our product manufacturers' current and future demands and timetables would have a material adverse effect on our revenues and cost of goods sold relating to sales of these materials to OLED product manufacturers, as well as on our ability to perform future development work.

Additionally, PPG manufactures our materials at its facilities based in the United States. As a result, such materials may be subject to tariffs or other barriers from or to countries where some of our product manufacturer customers have operations and to where we would need to ship product.

We strive to maintain sufficient levels of inventory to accommodate our manufacturing customers. Inventory management relating to our material sales is complex, and excess inventory may harm our business and cause it to suffer.

Inventory management remains an area of focus as we balance the need to maintain strategic inventory levels of our OLED materials to ensure competitive lead times against the risk of inventory obsolescence because of rapidly changing technology and customer requirements. As a just-in-time supplier to our customers, we carry sufficient inventory to accommodate their capacity requirements, sometimes without firm purchase commitments. Our dependence on third-party manufacturers to provide our materials to us exposes us to longer lead times than if we were a direct manufacturer, increasing our risk of inventory obsolescence comparatively. Our customers may increase orders during periods of product shortages, cancel orders if their inventory is too high, or delay orders in anticipation of new products. They also may adjust their orders in response to the supply and demand of their products by end-users, or the supply and demand of our products and the products of our competitors that are available to them.

Inventory management risks are heightened when our largest customers launch new products and retire existing products. At such times, these customers tend to change product designs and may introduce some of our new materials into new designs. The production of these materials requires us to purchase essential raw material and commence manufacturing well in advance of receiving firm customer orders for such materials. Accordingly, we are subject to the risk of unanticipated changes in our customers' manufacturing plans and designs. Unanticipated product cessation and product introduction delays or cancellation may cause us to order or produce excess or insufficient inventory. Excess inventory of our OLED materials is subject to the risk of inventory obsolescence. In the event that a substantial portion of our inventory becomes obsolete, it could have a material adverse effect on earnings due to the resulting costs associated with the inventory impairment charges and inventory write-downs.

We are the sole source supplier for certain critical components used in OLED technologies, which subjects customers to risk if we are unable to meet the demand for such components.

Our customers depend on us as the sole source for certain proprietary PHOLED materials used in manufacturing OLED products, which makes them susceptible to supply shortages if we are unable to meet their demand for such components. A potential customer could be hesitant to adopt OLED technology given the risks inherent in depending on a sole source for critical components and the inability to establish alternate supply relationships. If we are unable to supply the components needed by our existing customers in a timely manner, or if potential customers do not utilize OLED technology because of concerns about our ability to meet supply demands, our business may materially suffer.

Because the vast majority of OLED product manufacturers are located in the Asia-Pacific region, we are subject to international operational, financial, legal and political risks which may negatively impact our operations.

Many of our customers and prospective customers have a majority of their operations in countries other than the United States, particularly in the Asia-Pacific region, and revenue outside the United States represents a majority of our total net revenue. We also have offices in various countries located outside of the United States. Risks associated with our doing business outside of the United States include, without limitation:

- compliance with a wide variety of U.S. and foreign laws and regulations, including foreign anti-corruption laws and certain registration requirements for the OLED materials we sell;

- legal uncertainties regarding taxes, tariffs, quotas, export controls, export licenses and other trade barriers;
- economic instability in the countries of our customers, causing delays or reductions in orders for their products and therefore our royalties;
- political instability in the countries in which we and/or our customers operate, particularly in South Korea relating to its disputes with and proximity to North Korea, in Hong Kong relating to anti-government protests and in Taiwan relating to its disputes with China;
- third party theft or compromise of our products, technology, data or intellectual property, including by means of counterfeiting or reverse-engineering;
- difficulties in collecting accounts receivable and longer accounts receivable payment cycles;
- potentially adverse tax and tariff consequences; and
- trade conflicts between and among various geopolitical factions.

Any of these factors could impair our ability to license our OLED technologies and sell our OLED materials, thereby harming our business. Compliance with changing laws and regulations may involve significant costs or require changes in business practice that could result in reduced profitability.

We rely on information technology systems to operate various elements of our business and a cyber-attack or other breach of our systems, or those of third parties on whom we may rely, could subject us to liability or interrupt the operation of our business.

We are dependent on information technology systems to operate various elements of our business. A breakdown, invasion, corruption, destruction or interruption of critical information technology systems by employees, others with authorized access to our systems or unauthorized persons could negatively impact operations. In the ordinary course of business, we collect, store and transmit important data and it is critical that we do so in a secure manner to maintain the confidentiality and integrity of such information. Additionally, we outsource certain elements of our information technology systems to third parties. As a result of this outsourcing, our third-party vendors may or could have access to our confidential information making such systems vulnerable. Data breaches of our information technology systems, or those of our third-party vendors, may pose a risk that sensitive data may be exposed to unauthorized persons or to the public. While we believe that we have taken appropriate security measures to protect our data and information technology systems, and have been informed by our third-party vendors that they have as well, there can be no assurance that our efforts will prevent breakdowns or breaches in our systems, or those of our third-party vendors, that could adversely affect our business.

Natural disasters or other unforeseen catastrophic events could unfavorably affect our business.

Natural disasters, such as hurricanes, tsunamis, or earthquakes, particularly in Asia-Pacific region, where many of our customers are located, or the occurrence of other unforeseen catastrophic events, such a fire or flood, could unfavorably affect our business and financial performance. Such events could unfavorably affect our customers in many ways, such as causing physical damage to one or more of their properties, the temporary or permanent closure of one or more plants, the disruption or cessation of manufacturing of product lines, and the temporary or long-term disruption in the supply or demand for their products. A resulting by-product of such natural disasters or other unforeseen catastrophic events could be a temporary or long-term disruption in the supply of or demand for our products.

Risks Related to Legal, Regulatory and Tax Matters

We may be subject to environmental laws and regulations that impose additional compliance costs and that could negatively impact our business.

Changes in environmental laws or regulations of our products could result in higher operating and compliance expenses and limit the markets in which we can manufacture and to which we can export our products. Changes in environmental laws or regulations, including laws relating to manufacturing operations and export restrictions, also could lead to new or additional investment in product designs and an increase in raw materials costs, and could increase our environmental compliance expenditures. If environmental laws or regulations are either changed or adopted and impose additional operational restrictions and compliance requirements upon us or our products, they could negatively impact our business, capital expenditures, results of operations and financial condition.

The U.S. government has rights to intellectual property derived from our government-funded work that might prevent us from realizing the full benefits of our intellectual property portfolio.

The U.S. government, through various government agencies, has provided and continues to provide funding to us, Princeton, USC and Michigan for work related to certain aspects of our OLED technologies. Because we have been provided with this funding, the government has rights to any intellectual property derived from this work that could restrict our ability to market OLED products to the government for military and other applications, or to license this intellectual property to third parties for commercial applications. Moreover, if the government determines that we have not taken effective steps to achieve practical application of this intellectual property in any field of use in a reasonable time, the government could require us to license this intellectual property to other parties in that field of use. Any of these occurrences would limit our ability to obtain maximum value from our intellectual property portfolio.

Our effective tax rate may increase or decrease.

We are subject to income taxes in the U.S. and numerous foreign jurisdictions. Significant judgment is required in determining our worldwide provision for income taxes. In the ordinary course of our business, there are many transactions and calculations where the ultimate tax determination is uncertain. We are subject to audit by tax authorities where we do business. Although we believe that our tax estimates and tax positions are reasonable, they could be materially affected by many factors including the final outcome of tax audits and related litigation, the introduction of new tax accounting standards, legislation, regulations, and related interpretations, our global mix of earnings and the realizability of deferred tax assets. An increase or decrease in our effective tax rate could have a material adverse impact on our financial condition and results of operations.

In addition, at any time, U.S. federal tax laws or the administrative interpretations of those laws may be changed. In December 2017, the legislation commonly referred to as the Tax Cuts and Jobs Act, which made widespread changes to the Internal Revenue Code, was signed into law. While we believe that this law generally will have a favorable effect on U.S. corporations and their shareholders, uncertainty remains regarding the full effect that this law will have on us, particularly given the global nature of our operations, or the impact on our customers, vendors, shareholders and other stakeholders. We also cannot predict whether, when or to what extent other new U.S. federal tax laws, regulations, interpretations or rulings will be issued. As a result, changes in U.S. federal tax laws could negatively impact our operating results, financial condition and business operations, and adversely impact our shareholders.

Occasionally, changes in state and local tax laws or regulations are enacted that may result in an increase in our tax liability. Shortfalls in tax revenues for states and municipalities in recent years may lead to an increase in the frequency and size of such changes. If such changes occur, we may be required to pay additional taxes on our assets or income.

Risks Related to Our Stock and Capitalization

We may require additional funding in the future in order to continue our business.

Our capital requirements have been and will continue to be significant. We may require additional funding in the future for the research, development and commercialization of our OLED technologies and materials, to obtain and maintain patents and other intellectual property rights in these technologies and materials, and for working capital and other purposes, the timing and amount of which are difficult to ascertain. Our cash on hand may not be sufficient to meet all of our future needs. When we need additional funds, such funds may not be available on commercially reasonable terms or at all. If we cannot obtain more money when needed, our business might fail. Additionally, if we attempt to raise money in an offering of shares of our common stock, preferred stock, warrants or depositary shares, or if we engage in acquisitions involving the issuance of such securities, the issuance of these shares will dilute our then-existing shareholders.

The market price of our common stock may be highly volatile.

The market price of our common stock may be highly volatile, as has been the case with our common stock in the past as well as the securities of many companies, particularly other emerging-growth companies in the technology industry. We have included in the section of this report entitled "Market for Registrant's Common Equity, Related Stockholder Matters and Issuer Purchases of Equity Securities," a table indicating the high and low closing prices of our common stock as reported on the NASDAQ Global Market for the past two years. Factors such as the following may have a significant impact on the market price of our common stock in the future:

- our revenues, expenses and operating results;
- announcements by us, by our customers, or our competitors of technological developments, new product applications or contractual arrangements;
- announcements relating to dividends and share repurchases; and

- other factors affecting the display and solid-state lighting industries in general.

Our operating results may have significant period-to-period fluctuations, which would make it difficult to predict our future performance.

Due to the current stage of commercialization of our OLED technologies and materials, current geopolitical risks, the limited number of commercially successful consumer products utilizing our OLED technologies that customers have introduced in the marketplace, the relatively short product lifetimes of these consumer products, and the significant development and manufacturing objectives that we and our customers must achieve for the widespread inclusion of our OLED technologies in consumer products such as mobile phones, tablets, television displays and lighting products, our quarterly operating results are difficult to predict and may vary significantly from quarter to quarter.

We believe that period-to-period comparisons of our operating results are not a reliable indicator of our future performance at this time. Among other factors affecting our period-to-period results, our license and technology development fees often consist of large one-time, annual, semi-annual or quarterly payments, which may result in significant fluctuations in our revenues. In addition, our reliance on a relatively small number of licensees with large volumes of consumer product sales makes our quarterly operating results subject to our licensees' specific plans and the success of their specific product offerings.

With respect to material sales, our sales are primarily dependent on purchases made by a relatively small number of customers. In addition to the other factors described above relating to our customers' sales opportunities, our quarter-to-quarter sales may be materially impacted by our customers' inventory management plans, which may vary substantially based on financial management considerations, changes in their product mix plans, modified material processing techniques and manufacturing line modifications.

If, in some future period, our operating results or business outlook fall below the expectations of securities analysts or investors, our stock price would be likely to decline and investors in our common stock may not be able to resell their shares at or above their purchase price. Broad market, industry and global economic factors may also materially reduce the market price of our common stock, regardless of our operating performance.

The issuance of additional shares of our common stock could drive down the price of our stock.

The price of our common stock could decrease if:

- shares of our common stock that are currently subject to restriction on sale become freely salable, whether through an effective registration statement or based on Rule 144 under the Securities Act of 1933, as amended; or
- we issue additional shares of our common stock that might be or become freely salable, including shares that would be issued upon conversion of our preferred stock or the exercise of outstanding stock options.

We can issue shares of preferred stock that may adversely affect the rights of shareholders of our common stock.

Our Articles of Incorporation authorize us to issue up to 5,000,000 shares of preferred stock with designations, rights and preferences determined from time-to-time by our Board of Directors. Accordingly, our Board of Directors is empowered, without shareholder approval, to issue preferred stock with dividend, liquidation, conversion, voting or other rights superior to those of shareholders of our common stock. For example, an issuance of shares of preferred stock could:

- adversely affect the voting power of the shareholders of our common stock;
- make it more difficult for a third party to gain control of us;
- discourage bids for our common stock at a premium; or
- otherwise adversely affect the market price of our common stock.

As of February 18, 2021, we have issued and outstanding 200,000 shares of Series A Nonconvertible Preferred Stock, all of which are held by an entity controlled by members of the family of Sherwin I. Seligsohn, our Founder and Chairman of the Board of Directors. Our Board of Directors has authorized and issued other shares of preferred stock in the past, none of which are currently outstanding, and may do so again at any time in the future.

Any decisions to reduce or discontinue paying cash dividends to our shareholders could cause the market price for our common stock to decline.

In 2017, our Board of Directors began declaring quarterly cash dividends on our common stock, which we have consistently paid since then and we intend to continue to pay in the future. However, payment of future cash dividends will be at the discretion of our Board of Directors and will depend upon our results of operations, earnings, capital requirements, contractual restrictions and other factors deemed relevant by our Board of Directors. As such, we may modify, suspend or cancel our cash dividend policy in any manner and at any time. Any reduction or discontinuance by us of the payment of quarterly cash dividends could cause the market price of our common stock to decline. Moreover, in the event our payment of quarterly cash dividends are reduced or discontinued, our failure or inability to resume paying cash dividends at historical levels could cause the market price of our common stock to decline. There is no guarantee that our common stock will appreciate in value or even maintain the price at which current shareholders purchased their shares.

Our executive officers and directors own a significant percentage of our common stock and could exert significant influence over matters requiring shareholder approval, including takeover attempts.

Our executive officers and directors and their respective affiliates and the adult children of Sherwin Seligsohn, beneficially own, as of February 18, 2021, approximately 8.6% of the outstanding shares of our common stock. Accordingly, these individuals may, as a practical matter, be able to exert significant influence over matters requiring approval by our shareholders, including the election of directors and the approval of mergers or other business combinations. This concentration also could have the effect of delaying or preventing a change in control of us.

ITEM 1B. *UNRESOLVED STAFF COMMENTS*

None.

ITEM 2. *PROPERTIES*

Our corporate offices and research and development laboratories are located at 375 Phillips Boulevard in Ewing, New Jersey. In 2004, we acquired the building and property at which this facility is located. During 2005, we conducted a two-stage expansion of our laboratory and office space in the building, as well as a recent expansion in 2013 and 2015. We currently occupy the entire newly expanded facility. In 2017, we acquired the building and property at which the Adesis facility is located at 27 McCullough Drive in New Castle, Delaware. In 2019, we purchased 250 and 300 Phillips Boulevard in Ewing, New Jersey, adjacent to our headquarters. The new facilities added approximately 88,000 square feet and will allow for the expansion of research and development activities, manufacturing logistics and other corporate functions.

ITEM 3. *LEGAL PROCEEDINGS*

Patent Related Challenges and Oppositions

Each major jurisdiction in the world that issues patents provides both third parties and applicants an opportunity to seek a further review of an issued patent. The process for requesting and considering such reviews is specific to the jurisdiction that issued the patent in question, and generally does not provide for claims of monetary damages or a review of specific claims of infringement. The conclusions made by the reviewing administrative bodies tend to be appealable and generally are limited in scope and applicability to the specific claims and jurisdiction in question.

We believe that opposition proceedings are frequently commenced in the ordinary course of business by third parties who may believe that one or more claims in a patent do not comply with the technical or legal requirements of the specific jurisdiction in which the patent was issued. We view these proceedings as reflective of our goal of obtaining the broadest legally permissible patent coverage permitted in each jurisdiction. Once a proceeding is initiated, as a general matter, the issued patent continues to be presumed valid until the jurisdiction's applicable administrative body issues a final non-appealable decision. Depending on the jurisdiction, the outcome of these proceedings could include affirmation, denial or modification of some or all of the originally issued claims. We believe that as OLED technology becomes more established and our patent portfolio increases in size, so will the number of these proceedings.

Below is a summary of an active proceeding that has been commenced against an issued patent that is exclusively licensed to us. We do not believe that the confirmation, loss or modification of our rights in any individual claim or set of claims that are the subject of the following legal proceeding would have a material impact on our materials sales or licensing business or on our Consolidated Financial Statements, including our Consolidated Statements of Income, as a whole. However, as noted within the description, the following proceeding involves an issued patent that relates to our fundamental phosphorescent OLED technologies and we intend to vigorously defend against claims that, in our opinion, seek to restrict or reduce the scope of the originally issued claim, which may require the expenditure of significant amounts of our resources. In certain circumstances, when permitted, we may also utilize a

proceeding to request modification of the claims to better distinguish the patented invention from any newly identified prior art and/or improve the claim scope of the patent relative to commercially important categories of the invention.

Opposition to European Patent No. 1390962

On November 16, 2011, Osram AG and BASF SE each filed a Notice of Opposition to European Patent No. 1390962 (the EP '962 patent), which relates to the Company's white phosphorescent OLED technology. The EP '962 patent, which was issued on February 16, 2011, is a European counterpart patent to U.S. patents 7,009,338 and 7,285,907. They are exclusively licensed to us by Princeton, and we are required to pay all legal costs and fees associated with this proceeding.

The European Patent Office (EPO) combined the oppositions into a single opposition proceeding, and a hearing on this matter was held in December 2015, wherein the EPO Opposition Division revoked the patent claims for alleged insufficiencies under European Patent Convention Article 83. We believe the EPO's decision is erroneous and appealed the decision. Subsequent to the filing of the appeal, BASF withdrew its opposition to the patent. On appeal, the Appeals Division withdrew the lower Opposition Division's rejections with respect to a portion of the original subject matter and remanded the matter to the lower Opposition Division for further consideration. The patent, as originally granted, is deemed valid during the pendency of the opposition process.

At this time, based on our current knowledge, we believe that the patent being challenged should be declared valid and that a significant portion of our claims should be upheld. However, we cannot make any assurances of this result.

In addition to the above proceeding and now concluded proceedings which have been referenced in prior filings, from time to time, we may have other proceedings that are pending which relate to patents we acquired as part of the Fujifilm patent or BASF OLED patent acquisitions or which relate to technologies that are not currently widely used in the marketplace.

ITEM 4. ***MINE SAFETY DISCLOSURES***

Not applicable.

PART II

ITEM 5. *MARKET FOR REGISTRANT'S COMMON EQUITY, RELATED STOCKHOLDER MATTERS AND ISSUER PURCHASES OF EQUITY SECURITIES*

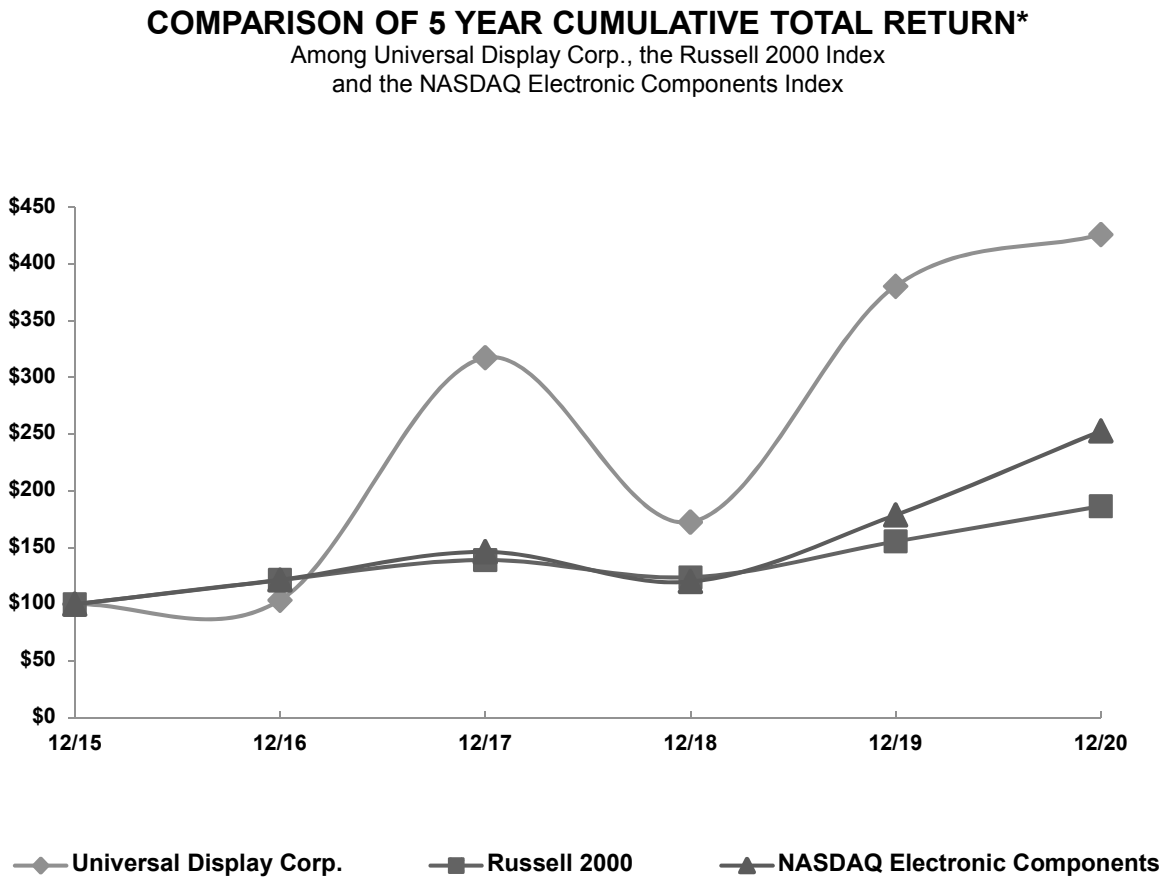
Our Common Stock

Our common stock is quoted on the NASDAQ Global Market under the symbol "OLED." As of February 18, 2021, there were approximately 317 holders of record of our common stock.

During 2018, 2019 and 2020, we declared and paid cash dividends on our common stock. While we intend to pay regular quarterly dividends in the future, payment of future cash dividends will be at the discretion of our Board of Directors and will depend upon our results of operations, earnings, capital requirements, contractual restrictions and other factors deemed relevant by our Board of Directors. As such, we may modify, suspend or cancel our cash dividend policy in any manner and at any time.

Performance Graph

The performance graph below compares the change in the cumulative shareholder return of our common stock from December 31, 2015 to December 31, 2020, with the percentage change in the cumulative total return over the same period on (i) the Russell 2000 Index, and (ii) the Nasdaq Electronics Components Index. This performance graph assumes an initial investment of $100 on December 31, 2015 in each of our common stock, the Russell 2000 Index and the Nasdaq Electronics Components Index.



	Cumulative Total Return					
	12/15	12/16	12/17	12/18	12/19	12/20
Universal Display Corp.	100.00	103.42	317.46	172.43	380.61	426.04
Russell 2000	100.00	121.31	139.08	123.76	155.35	186.36
NASDAQ Electronic Components	100.00	121.48	146.21	119.92	178.71	252.83

Securities Authorized for Issuance under Equity Compensation Plans

The information required by this item with respect to our equity compensation plans will be set forth in our definitive Proxy Statement for the 2021 Annual Meeting of Shareholders, and is incorporated herein by reference.

ITEM 6. *SELECTED FINANCIAL DATA*

The following selected consolidated financial data has been derived from, and should be read in conjunction with, our Consolidated Financial Statements and the notes thereto, and with "Management's Discussion and Analysis of Financial Condition and Results of Operations," included elsewhere in this report.

(in thousands, except share and per share data)	Year Ended December 31,				
	2020	2019	2018	2017	2016
Operating Results:					
Total revenue	$ 428,867	$ 405,177	$ 247,414	$ 335,629	$ 198,886
Cost of sales (1)	85,478	75,374	53,541	54,698	26,288
Research and development expense	83,894	71,276	53,717	49,144	42,744
Selling, general and administrative expense	61,346	59,613	46,999	46,808	32,876
Amortization of acquired technology and other intangible assets	21,969	21,962	21,962	21,983	16,493
Patent costs	7,529	6,833	7,464	7,010	6,249
Interest income, net	5,139	10,795	7,659	3,294	2,113
Income tax expense	(30,157)	(31,601)	(5,471)	(45,652)	(20,528)
Net income	133,372	138,304	58,840	103,885	48,070
Net income per common share, basic	$ 2.80	$ 2.92	$ 1.24	$ 2.19	$ 1.02
Net income per common share, diluted	$ 2.80	$ 2.92	$ 1.24	$ 2.18	$ 1.02
Balance Sheet Data:					
Total assets	$ 1,269,228	$ 1,120,157	$ 933,424	$ 779,956	$ 627,559
Current liabilities	164,960	161,508	133,182	63,824	40,206
Shareholders' equity	912,714	811,449	690,506	659,054	528,468
Other Financial Data:					
Working capital	$ 759,646	$ 630,931	$ 501,658	$ 455,358	$ 345,164
Capital expenditures	27,991	30,059	25,391	29,803	7,300
Purchase of intangibles	60	401	—	—	95,989
Weighted average shares used in computing basic net income per common share	47,198,982	46,959,775	46,849,588	46,725,289	46,408,460
Weighted average shares used in computing diluted net income per common share	47,236,994	46,995,462	46,896,766	46,805,194	46,535,980
Shares of common stock outstanding, end of period	47,647,828	47,486,545	47,319,887	47,118,171	46,913,127

(1) During the years ended December 31, 2020, 2019 and 2018, the Company recorded an increase in inventory reserve of $1.1 million, $5.9 million and $3.6 million, respectively, due to excess inventory levels in certain products.

ITEM 7. *MANAGEMENT'S DISCUSSION AND ANALYSIS OF FINANCIAL CONDITION AND RESULTS OF OPERATIONS*

The following discussion and analysis of our financial condition and results of operations should be read in conjunction with the section entitled "Selected Financial Data" in this report and our Consolidated Financial Statements and related notes to this report. This discussion and analysis contains forward-looking statements based on our current expectations, assumptions, estimates and projections. These forward-looking statements involve risks and uncertainties. Our actual results could differ materially from those indicated in these forward-looking statements as a result of certain factors, as more fully discussed in Item 1A of this report, entitled "Risk Factors."

OVERVIEW

We are a leader in the research, development and commercialization of organic light emitting diode (OLED), technologies and materials for use in display applications, such as mobile phones, televisions, wearables, tablets, portable media devices, notebook computers, personal computers and automotive applications, as well as specialty and general lighting products. Since 1994, we have been engaged and expect to continue to be primarily engaged, in funding and performing research and development activities relating to OLED technologies and materials, and commercializing these technologies and materials. We derive our revenue primarily from the following:

- sales of OLED materials for evaluation, development and commercial manufacturing;
- intellectual property and technology licensing;
- technology development and support, including third-party collaboration efforts and providing support to third parties for commercialization of their OLED products; and
- contract research services in the areas of chemical materials synthesis research, development and commercialization for non-OLED applications.

Material sales relate to our sale of OLED materials for incorporation into our customers' commercial OLED products or for their OLED development and evaluation activities. Material sales are generally recognized at the time title passes, which is typically at the time of shipment or at the time of delivery, depending upon the contractual agreement between the parties.

We receive license and royalty payments under certain commercial, development and technology evaluation agreements, some of which are non-refundable advances. These payments may include royalty and license fees made pursuant to license agreements and also license fees included as part of certain commercial supply agreements. These payments are included in the estimate of total contract consideration by customer and recognized as revenue over the contract term based on material units sold at the estimated per unit fee over the life of the contract.

In 2018, we entered into a commercial patent license agreement with Samsung Display Co., Ltd. (SDC). This agreement, which covers the manufacture and sale of specified OLED display materials, was effective as of January 1, 2018 and lasts through the end of 2022 with an additional two-year extension option. Under this agreement, we are being paid a license fee, payable in quarterly installments over the agreement term of five years. The agreement conveys to SDC the non-exclusive right to use certain of our intellectual property assets for a limited period of time that is less than the estimated life of the assets.

At the same time that we entered into the current license agreement with SDC, we also entered into a material purchase agreement with SDC. Under the material purchase agreement, SDC agrees to purchase from us a minimum amount of phosphorescent emitter materials for use in the manufacture of licensed products. This minimum commitment is subject to SDC's requirements for phosphorescent emitter materials and our ability to meet these requirements over the term of the supplemental agreement.

In 2015, we entered into an OLED patent license agreement and an OLED commercial supply agreement with LG Display Co., Ltd. (LG Display), which were effective as of January 1, 2015. The agreements have a term that is set to expire by the end of 2022. The patent license agreement provides LG Display a non-exclusive, royalty bearing portfolio license to make and sell OLED displays under our patent portfolio. The patent license calls for license fees, prepaid royalties and running royalties on licensed products. The agreements include customary provisions relating to warranties, indemnities, confidentiality, assignability and business terms. The agreements provide for certain other minimum obligations relating to the volume of material sales anticipated over the life of the agreements as well as minimum royalty revenue to be generated under the patent license agreement. We generate revenue under these agreements that are predominantly tied to LG Display's sales of OLED licensed products. The OLED commercial supply agreement provides for the sales of materials for use by LG Display, which may include phosphorescent emitters and host materials.

In 2016, we entered into long-term, multi-year OLED patent license and material purchase agreements with Tianma Micro-electronics Co., Ltd. (Tianma). Under the license agreement, we have granted Tianma non-exclusive license rights under various patents owned or controlled by us to manufacture and sell OLED display products. The license agreement calls for license fees and running royalties on Tianma's sales of licensed products. Additionally, we supply phosphorescent OLED materials to Tianma for use in its licensed products.

In 2017, we entered into long-term, multi-year agreements with BOE Technology Group Co., Ltd. (BOE). Under these agreements, we have granted BOE non-exclusive license rights under various patents owned or controlled by us to manufacture and sell OLED display products. We also supply phosphorescent OLED materials to BOE for use in its licensed products.

In 2018, we entered into long-term, multi-year OLED patent license and material purchase agreements with Visionox Technology, Inc. (Visionox). Under the license agreement, we have granted Visionox non-exclusive license rights under various patents owned or controlled by us to manufacture and sell OLED display products. The license agreement calls for license fees and running royalties on Visionox's sales of licensed products. Additionally, we supply phosphorescent OLED materials to Visionox for use in its licensed products.

In 2019, we entered into an evaluation and commercial supply relationship with Wuhan China Star Optoelectronics Semiconductor Display Technology Co., Ltd. (CSOT). In 2020, we entered into long-term, multi-year agreements with CSOT. Under these agreements, we have granted CSOT non-exclusive license rights under various patents owned or controlled by us to manufacture and sell OLED display products. We also supply phosphorescent OLED materials to CSOT for use in licensed products.

In 2016, we acquired Adesis, Inc. (Adesis) with operations in New Castle, Delaware. Adesis is a contract research organization (CRO) that provides support services to the OLED, pharma, biotech, catalysis and other industries. As of December 31, 2020, Adesis employed a team of 100 research scientists, chemists, engineers and laboratory technicians. Prior to our acquisition of Adesis in 2016, we utilized more than 50% of Adesis' technology service and production output. We continue to utilize a significant portion of its technology research capacity for the benefit of our OLED technology development, and Adesis uses the remaining capacity to operate as a CRO in the above-mentioned industries by providing contract research services for non-OLED applications to those third-party customers. Contract research services revenue is earned by providing chemical materials synthesis research, development and commercialization for non-OLED applications on a contractual basis for those third-party customers.

In June 2020, a wholly-owned subsidiary, OVJP Corporation (OVJP Corp), was formed as a Delaware corporation. Based out of California, OVJP Corp was founded to advance the commercialization of our proprietary Organic Vapor Jet Printing (OVJP) technology. As a direct printing technique, OVJP technology has the potential to offer high deposition rates for large-area OLEDs. In addition, OVJP technology reduces OLED material waste associated with use of a shadow mask (i.e., the waste of material that deposits on the shadow mask itself when fabricating an OLED). By comparison to inkjet printing, an OVJP process does not use liquid solvents and therefore the OLED materials utilized are not limited by their viscosity or solvent solubility. OVJP also avoids generation of solvent wastes and eliminates the additional step of removing residual solvent from the OLED device. We believe the successful implementation of the OVJP technology has the potential to increase the addressable market for large-size OLED panels while also serving another potential growth market for our proprietary PHOLED materials and technologies.

We also generate technology development and support revenue earned from development and technology evaluation agreements and commercialization assistance fees, along with, to a minimal extent, government contracts. Relating to our government contracts, we may receive reimbursements by government entities for all or a portion of the research and development costs we incur. Revenues are recognized as services are performed, proportionally as research and development costs are incurred, or as defined milestones are achieved.

We anticipate fluctuations in our annual and quarterly results of operations due to uncertainty regarding, among other factors:

- the timing, cost and volume of sales of our OLED materials;
- the timing of our receipt of license fees and royalties, as well as fees for future technology development and evaluation;
- the timing and magnitude of expenditures we may incur in connection with our ongoing research and development and patent-related activities; and
- the timing and financial consequences of our formation of new business relationships and alliances.

Further, we continue to monitor the impact of COVID-19 on our business. Our global operations, and the global nature of our customer base and their respective customers, expose us to risks associated with public health crises, such as pandemics and epidemics. The ongoing COVID-19 pandemic had a substantial impact on our operations and financial results during the year ended December 31, 2020. We expect that as the pandemic continues to evolve, it can potentially have a further adverse impact on the results of our operations due to uncertainties involving the continued disruption of the global economy, uncertainties associated with consumer demand for finished OLED goods, and the potential resulting impact on our customers and their demand for our phosphorescent emitters.

At this time, the crisis has not had a significant impact on our ability to fulfill shipments of commercial materials as required by our customers. However, the sustainability of maintaining our testing and manufacturing operations at levels needed to meet fluctuating customer demand is uncertain and is dependent upon the rapidly evolving situations being encountered by our logistics and supply chain partners. In an effort to protect the health and safety of our employees, we have taken proactive measures to adopt social distancing policies at all of our locations, employing nurses to check everyone entering our buildings, working from home, reducing the number of people in our sites at any one time, and suspending employee travel.

While the ultimate health and economic impact of the COVID-19 pandemic is highly uncertain, we expect that our business operations and results of operations, including our revenues, net income and cash flows, will continue to be adversely impacted for at least the first half of 2021, including as a result of:

- temporary closure of electronics and other retail stores through which our customers sell the products for which they use our technology and materials;
- consumer confidence and consumer spending habits, including spending for the products that our customers sell and negative trends in consumer purchasing patterns due to consumers' disposable income, credit availability and debt levels;
- possible disruption to the supply chain caused by distribution and other logistical issues, which may impact suppliers of our raw materials as well as our ability to ship our materials to customers on a timely basis;
- decreased productivity due to travel ban, work-from-home policies or shelter-in-place orders;
- a slowdown in the U.S. economy, and uncertain global economic outlook or a credit crisis; and
- uncertain trade restrictions amongst jurisdictions seeking to manage their respective exposure to risks, including the COVID-19 pandemic.

We are focused on navigating these recent challenges presented by COVID-19 through preserving our liquidity and managing our cash flow. We continue to actively monitor the COVID-19 situation and may take further actions altering our business operations that we determine are in the best interests of our employees, customers, partners, suppliers, and stakeholders, or as required by federal, state, or local authorities. It is not clear what the potential effects any such alterations or modifications may have on our business, including the effects on our customers, employees, and on our financial results for the 2021 fiscal year.

Critical Accounting Policies and Estimates

The discussion and analysis of our financial condition and results of operations is based on our Consolidated Financial Statements, which have been prepared in accordance with U.S. generally accepted accounting principles. The preparation of these financial statements requires us to make estimates and judgments that affect our reported assets and liabilities, revenues and expenses, and other financial information. Actual results may differ significantly from our estimates under other assumptions and conditions.

We believe that our accounting policies related to revenue recognition and deferred revenue and income taxes, as described below, are our "critical accounting policies" as contemplated by the SEC. These policies, which have been reviewed with our Audit Committee, are discussed in greater detail below.

Revenue Recognition and Deferred Revenue

Material sales relate to the sale of our OLED materials for incorporation into our customers' commercial OLED products or for their OLED development and evaluation activities. Revenue associated with material sales is generally recognized at the time title passes, which is typically at the time of shipment or at the time of delivery, depending upon the contractual agreement between the parties. Revenue may be recognized after control of the material passes in the event the transaction price includes variable consideration. For example, a customer may be provided an extended opportunity to stock materials prior to use in mass production and given a general right of return not conditioned on breaches of warranties associated with the specific product. In such

circumstances, revenue will be recognized at the earlier of the expiration of the customer's general right of return or once it becomes unlikely that the customer will exercise its right of return.

The rights and benefits to our OLED technologies are conveyed to the customer through technology license agreements and material supply agreements. We believe that the licenses and materials sold under these combined agreements are not distinct from each other for financial reporting purposes and as such, are accounted for as a single performance obligation. Accordingly, total contract consideration, including material, license and royalty fees, is estimated and recognized over the contract term based on material units sold at the estimated per unit fee over the life of the contract.

Various estimates are relied upon to recognize revenue. We estimate total material units to be purchased by our customers over the contract term based on historical trends, industry estimates and our forecast process. Our management uses the expected value method to estimate the material per unit fee. Additionally, our management estimates the total sales-based royalties based on the estimated net sales revenue of our customers over the contract term.

Accounting for Income Taxes

We are subject to income taxes in both the U.S. and foreign jurisdictions. Significant judgments and estimates are required in evaluating our tax positions for future realization and determining our provision for income taxes. Our income tax expense, deferred tax assets and liabilities, and reserves for unrecognized tax benefits reflect management's best assessment of estimated future taxes to be paid.

In assessing the realizability of deferred tax assets, we consider whether it is more likely than not that some portion or all of our deferred tax assets will not be realized. The ultimate realization of deferred tax assets is dependent on our ability to generate future taxable income to obtain benefit from the reversal of temporary differences, net operating loss carryforwards and tax credits. As part of our assessment we consider the scheduled reversal of deferred tax assets and liabilities, projected future taxable income, and tax planning strategies.

During the year ended December 31, 2020, based on previous earnings history, a current evaluation of expected future taxable income and other evidence, we determined to retain the valuation allowance that relates to New Jersey research and development credits. Actual results could differ from our assessments if adequate taxable income is generated in future periods. To the extent we establish a new valuation allowance or change a previously established valuation allowance in a future period, income tax expense will be impacted.

RESULTS OF OPERATIONS

For a discussion of our results of operations comparison for 2019 and 2018, refer to our Annual Report on Form 10-K for the fiscal year ended December 31, 2019 filed on February 20, 2020.

Comparison of the Years Ended December 31, 2020 and 2019

	Year Ended December 31,		
	2020	2019	(Decrease) Increase
REVENUE:			
Material sales	$ 229,749	$ 243,413	$ (13,664)
Royalty and license fees	185,054	150,022	35,032
Contract research services	14,064	11,742	2,322
Total revenue	428,867	405,177	23,690
COST OF SALES	85,478	75,374	10,104
Gross margin	343,389	329,803	13,586
OPERATING EXPENSES:			
Research and development	83,894	71,276	12,618
Selling, general and administrative	61,346	59,613	1,733
Amortization of acquired technology and other intangible assets	21,969	21,962	7
Patent costs	7,529	6,833	696
Royalty and license expense	11,125	11,776	(651)
Total operating expenses	185,863	171,460	14,403
OPERATING INCOME	157,526	158,343	(817)
Interest income, net	5,139	10,795	(5,656)
Other income, net	864	767	97
Interest and other income, net	6,003	11,562	(5,559)
INCOME BEFORE INCOME TAXES	163,529	169,905	(6,376)
INCOME TAX EXPENSE	(30,157)	(31,601)	1,444
NET INCOME	$ 133,372	$ 138,304	$ (4,932)

Revenue

Our total material sales were $229.7 million for the year ended December 31, 2020, as compared to $243.4 million for the year ended December 31, 2019, a decrease of 6% with a commensurate decrease in unit material volume of 3%. The decrease in material sales was due to the impact that the COVID-19 pandemic had on the global demand of OLED products utilizing our emitter material primarily during the second quarter of 2020. During the second half of 2020, OLED market conditions improved with our material sales demand returning to levels as those experienced prior to the pandemic as our customers' demand cycles ramped up in preparation of new generations of mobile phones as well as the continued expansion in the OLED television market. Even though we believe we have experienced the worst effects of the COVID-19 pandemic, we remain uncertain as to the possibility of its re-emergence and corresponding negative impact on OLED market demand.

- Green emitter sales for the year ended December 31, 2020, which include our yellow-green emitters, were $177.8 million as compared to $189.4 million for the year ended December 31, 2019 with unit material volumes decreasing by 2%.
- Red emitter sales for the year ended December 31, 2020 were $51.0 million as compared to $53.2 million for the year ended December 31, 2019 with unit material volumes decreasing by 6%.

Revenue from royalty and license fees was $185.1 million for the year ended December 31, 2020 as compared to $150.0 million for the year ended December 31, 2019, an increase of 23%, as our customer's sales of royalty bearing OLED licensed products strengthened in the latter half of 2020.

Contract research services revenue was $14.1 million for the year ended December 31, 2020 as compared to $11.7 million for the year ended December 31, 2019, an increase of 20%. Revenue from contract research services consists of revenue earned by our subsidiary, Adesis, which provides support services to the pharma, biotech, catalysis and other industries on a contractual basis for those third-party customers.

Cost of Sales

Cost of sales for the year ended December 31, 2020 increased by $10.1 million as compared to the year ended December 31, 2019, primarily due to an increase in manufacturing costs partially offset by a decrease relating to the lower amount of material sales. The increase in manufacturing costs was primarily due to higher costs incurred during the quarter ended December 31, 2020, associated with increased levels of product development required to meet our customer's requests as they launched the next wave of new product introductions into the OLED market. We believe this is a temporary condition and manufacturing costs will return to previous trend-levels as the current product introductions are brought to market and begin to mature. Also included in the cost of sales for the years ended December 31, 2020 and 2019 was an increase in inventory reserve of $1.1 million and $5.9 million, respectively, due to excess inventory levels in certain products. As a result of the increase in revenue from royalty and license fees partially offset by a decrease in material sales and an increase in manufacturing costs, gross margin for the year ended December 31, 2020 increased by $13.6 million as compared to the year ended December 31, 2019, with gross margin as a percentage of revenue decreasing to 80% from 81%.

Research and development

Research and development expenses increased to $83.9 million for the year ended December 31, 2020, as compared to $71.3 million for the year ended December 31, 2019. The increase in research and development expenses was primarily due to higher employee-related compensation expenses and operating costs, including increased contract research activity.

Selling, general and administrative

Selling, general and administrative expenses increased to $61.3 million for the year ended December 31, 2020, as compared to $59.6 million for the year ended December 31, 2019. The increase in selling, general and administrative expenses was primarily due to higher employee-related compensation expenses.

Amortization of acquired technology and other intangible assets

Amortization of acquired technology and other intangible assets was $22.0 million for each of the years ended December 31, 2020 and 2019. See Note 7 in Notes to Consolidated Financial Statements for further discussion.

Patent costs

Patent costs increased to $7.5 million for the year ended December 31, 2020, as compared to $6.8 million for the year ended December 31, 2019. The increase in patent costs reflected higher internal patent prosecution related activities.

Royalty and license expense

Royalty and license expense decreased to $11.1 million for the year ended December 31, 2020, as compared to $11.8 million for the year ended December 31, 2019. The decrease was due to decreased royalties incurred under our amended license agreement with Princeton, USC, and Michigan, resulting from a decrease in qualifying sales. See Note 10 in Notes to Consolidated Financial Statements for further discussion.

Interest and other income, net

Interest income, net was $5.1 million for the year ended December 31, 2020, as compared to $10.8 million for the year ended December 31, 2019. The decrease in interest income, net, was primarily due to a decrease in bond yields on available-for-sale investments held during the year ended December 31, 2020 over amounts held during 2019. Other income, net primarily consisted of net exchange gains and losses on foreign currency transactions and rental income. We recorded other income, net, of $864,000 for the year ended December 31, 2020, as compared to $767,000 for the year ended December 31, 2019.

Income tax expense

We are subject to income taxes in both the United States and foreign jurisdictions. The effective income tax rate was an expense of 18.4% and 18.6% for the years ended December 31, 2020 and 2019, respectively, and we recorded income tax expense of $30.2 million and $31.6 million, respectively, for those periods. The recorded amounts include deductions for employee share awards in excess of compensation costs ("windfalls") under Accounting Standards Update (ASU) No. 2016-09. For the year ended December 31, 2020, without the $1.7 million benefit of ASU No. 2016-09, the effective income tax rate and income tax expense would have been 19.5% and $31.9 million, respectively, and for the year ended December 31, 2019, without the $3.0 million benefit of ASU No. 2016-09, the effective income tax rate and income tax expense would have been 20.4% and $34.6 million, respectively.

Liquidity and Capital Resources

Our principal sources of liquidity are our cash and cash equivalents and our short-term investments. As of December 31, 2020, we had cash and cash equivalents of $630.0 million and short-term investments of $100.0 million, for a total of $730.0 million. This compares to cash and cash equivalents of $131.6 million and short-term investments of $514.5 million, for a total of $646.1 million, as of December 31, 2019.

Cash provided by operating activities for the year ended December 31, 2020 was $148.8 million resulting from $133.4 million of net income and $136.6 million due to changes in our operating assets and liabilities, partially offset by a $121.2 million reduction due to non-cash items including amortization of deferred revenue, amortization of intangibles and stock-based compensation. Changes in our operating assets and liabilities related to an increase in deferred revenue of $192.4 million and an increase in other liabilities of $10.1 million, partially offset by an increase in inventory of $28.8 million, an increase in accounts receivable of $21.8 million, a decrease in accounts payable and accrued expenses of $8.3 million and an increase in other assets of $7.0 million.

Cash provided by operating activities for the year ended December 31, 2019 was $193.9 million resulting from $138.3 million of net income and $139.5 million due to changes in our operating assets and liabilities, partially offset by a $83.9 million reduction due to non-cash items including amortization of deferred revenue, amortization of intangibles and stock-based compensation. Changes in our operating assets and liabilities related to an increase in deferred revenue of $157.3 million, an increase in accounts payable and accrued expenses of $15.5 million, an increase in other liabilities of $12.4 million and a decrease in inventory of $109,000, partially offset by an increase in other assets of $28.5 million and an increase in accounts receivable of $17.3 million.

Cash provided by investing activities was $391.3 million for the year ended December 31, 2020, as compared to cash used in investing activities of $238.7 million for the year ended December 31, 2019. The increase in cash provided by investing activities was due to the timing of maturities and purchases of investments resulting in net sales and maturities of $419.3 million for the year ended December 31, 2020, as compared to net purchases of $208.3 million for the year ended December 31, 2019, and a decrease in purchases of intangibles and property, plant and equipment of $2.4 million for the year ended December 31, 2020 compared to the year ended December 31, 2019. The decrease in property, plant and equipment purchases during 2020 was primarily due to improvements to our Ewing facilities in New Jersey as part of our plan to expand operations during 2019.

Cash used in financing activities was $41.7 million for the year ended December 31, 2020, as compared to $34.6 million for the year ended December 31, 2019. The increase was due to an increase in the cash payment of dividends in the current year of $9.6 million, partially offset by a decrease in the payment of withholding taxes related to stock-based compensation to employees of $1.6 million, a decrease in the repurchase of common stock of $649,000 and an increase in proceeds from the issuance of common stock of $287,000.

Working capital was $759.6 million as of December 31, 2020, compared to $630.9 million as of December 31, 2019. The increase was primarily due to an increase in cash and cash equivalents, inventory and accounts receivable, partially offset by a decrease in short-term investments.

We anticipate, based on our internal forecasts and assumptions relating to our operations (including, among others, assumptions regarding our working capital requirements, the progress of our research and development efforts, the availability of sources of funding for our research and development work, and the timing and costs associated with the preparation, filing, prosecution, maintenance, defense and enforcement of our patents and patent applications), that we have sufficient cash, cash equivalents and short-term investments to meet our obligations for at least the next twelve months.

We believe that potential additional financing sources for us include long-term and short-term borrowings and public and private sales of our equity and debt securities. It should be noted, however, that additional funding may be required in the future for research, development and commercialization of our OLED technologies and materials, to obtain, maintain and enforce patents respecting these technologies and materials, and for working capital and other purposes, the timing and amount of which are difficult to ascertain. There can be no assurance that additional funds will be available to us when needed, on commercially reasonable terms or at all, particularly in the current economic environment.

Contractual Obligations

As of December 31, 2020, we had the following contractual commitments (in thousands):

	Payments Due by Period				
Contractual Obligations	Total	Less than 1 year	1-3 years	3-5 years	More than 5 years
Estimated retirement plan benefit payments	$ 93,808	$ —	$ 12,366	$ 12,842	$ 68,600
Lease obligations	10,223	2,174	3,288	1,794	2,967
Purchasing obligations	13,721	13,721	—	—	—
Research related obligations	7,687	3,721	3,966	—	—
Minimum royalty obligation (1)	500	100	200	200	$100/year
Total (2)	$ 125,939	$ 19,716	$ 19,820	$ 14,836	$ 71,567

(1) Under the 1997 Amended License Agreement, we are obligated to pay Princeton minimum royalties of $100,000 per year until the agreement is no longer in effect. The agreement has no scheduled expiration date.

(2) See Note 16 to the Consolidated Financial Statements for discussion of obligations upon termination of employment of executive officers as a result of a change in our control.

Off-Balance Sheet Arrangements

As of December 31, 2020, we had no off-balance sheet arrangements in the nature of guarantee contracts, retained or contingent interests in assets transferred to unconsolidated entities (or similar arrangements serving as credit, liquidity or market risk support to unconsolidated entities for any such assets), or obligations (including contingent obligations) arising out of variable interests in unconsolidated entities providing financing, liquidity, market risk or credit risk support to us, or that engage in leasing, hedging or research and development services with us.

Recently Issued Accounting Pronouncements

Recently issued accounting pronouncements are addressed in Note 2 in the Notes to Consolidated Financial Statements.

ITEM 7A. *QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK*

We do not utilize financial instruments for trading purposes and hold no derivative financial instruments, other financial instruments or derivative commodity instruments that could expose us to significant market risk other than our investments disclosed in "Fair Value Measurements" in Note 4 to the Consolidated Financial Statements included herein. We generally invest in investment grade financial instruments to reduce our exposure related to investments. Our primary market risk exposure with regard to such financial instruments is to changes in interest rates, which would impact interest income earned on investments. However, based upon the conservative nature of our investment portfolio and current experience, we do not believe a decrease in investment yields would have a material negative effect on our interest income.

Substantially all our revenue is derived from outside of North America. All revenue is primarily denominated in U.S. dollars and therefore we bear no significant foreign exchange risk.

ITEM 8. *FINANCIAL STATEMENTS AND SUPPLEMENTARY DATA*

Our Consolidated Financial Statements and the related notes to those statements are attached to this report beginning on page F-1.

ITEM 9. *CHANGES IN AND DISAGREEMENTS WITH ACCOUNTANTS ON ACCOUNTING AND FINANCIAL DISCLOSURE*

None.

ITEM 9A. *CONTROLS AND PROCEDURES*

Evaluation of Disclosure Controls and Procedures

Our management, with the participation of our Chief Executive Officer and Chief Financial Officer, evaluated the effectiveness of our disclosure controls and procedures as of December 31, 2020. Based on that evaluation, the Chief Executive Officer and Chief Financial Officer concluded that our disclosure controls and procedures, as of the end of the period covered by this report, are effective to provide reasonable assurance that the information required to be disclosed by us in reports filed or submitted under the Securities Exchange Act of 1934, as amended, is (i) recorded, processed, summarized and reported within the time periods specified in

the SEC's rules and forms, and (ii) accumulated and communicated to our management, including the Chief Executive Officer and Chief Financial Officer, as appropriate to allow timely decisions regarding disclosure. However, a controls system, no matter how well designed and operated, cannot provide absolute assurance that the objectives of the controls system are met, and no evaluation of controls can provide absolute assurance that all control issues and instances of fraud, if any, within a company have been detected.

Management's Report on Internal Control over Financial Reporting and Report of Independent Registered Public Accounting Firm on Internal Control over Financial Reporting

The report of management on our internal control over financial reporting and the associated attestation report of our independent registered public accounting firm are set forth in Item 8 of this report.

Changes in Internal Control over Financial Reporting

There were no changes in our internal control over financial reporting during the quarter ended December 31, 2020 that have materially affected, or are reasonably likely to materially affect, our internal control over financial reporting.

ITEM 9B. *OTHER INFORMATION*

None.

PART III

ITEM 10. *DIRECTORS, EXECUTIVE OFFICERS AND CORPORATE GOVERNANCE*

Information with respect to this item is set forth in our definitive Proxy Statement for the 2021 Annual Meeting of Shareholders, which is to be filed with the Securities and Exchange Commission no later than April 30, 2021 (our Proxy Statement), and which is incorporated herein by reference. Information regarding our executive officers is included at the end of Item 1 in Part I of this report.

ITEM 11. *EXECUTIVE COMPENSATION*

Information with respect to this item will be set forth in our Proxy Statement, and is incorporated herein by reference.

ITEM 12. *SECURITY OWNERSHIP OF CERTAIN BENEFICIAL OWNERS AND MANAGEMENT AND RELATED STOCKHOLDER MATTERS*

Information with respect to this item will be set forth in our Proxy Statement, and is incorporated herein by reference.

ITEM 13. *CERTAIN RELATIONSHIPS AND RELATED TRANSACTIONS, AND DIRECTOR INDEPENDENCE*

Information with respect to this item will be set forth in our Proxy Statement, and is incorporated herein by reference.

ITEM 14. *PRINCIPAL ACCOUNTANT FEES AND SERVICES*

Information with respect to this item will be set forth in our Proxy Statement, and is incorporated herein by reference.

PART IV

ITEM 15. *EXHIBITS AND FINANCIAL STATEMENT SCHEDULES*

(a) The following documents are filed as part of this report:

(1) Financial Statements:

(2) Financial Statement Schedules:

None.

(3) Exhibits:

The following is a list of the exhibits filed as part of this report. Where so indicated by footnote, exhibits that were previously filed are incorporated by reference. For exhibits incorporated by reference, the location of the exhibit in the previous filing is indicated parenthetically, together with a reference to the filing indicated by footnote.

Exhibit Number	Description
3.1	Amended and Restated Articles of Incorporation of the registrant (1)
3.2	Amended and Restated Bylaws of the registrant (2)
4	Description of Securities(3)
10.1#	Amended and Restated Change in Control Agreement between the registrant and Sherwin I. Seligsohn, dated as of November 4, 2008 (4)
10.2#	Amended and Restated Change in Control Agreement between the registrant and Steven V. Abramson, dated as of November 4, 2008 (4)
10.3#	Amended and Restated Change in Control Agreement between the registrant and Sidney D. Rosenblatt, dated as of November 4, 2008 (4)
10.4#	Amended and Restated Change in Control Agreement between the registrant and Julia J. Brown, dated as of November 4, 2008 (4)
10.5#	Amended and Restated Change in Control Agreement between the registrant and Janice K. Mahon, dated as of November 4, 2008 (4)
10.6#	Non-Competition and Non-Solicitation Agreement between the registrant and Sherwin I. Seligsohn, dated as of February 23, 2007 (5)
10.7#	Non-Competition and Non-Solicitation Agreement between the registrant and Steven V. Abramson, dated as of January 26, 2007 (5)
10.8#	Non-Competition and Non-Solicitation Agreement between the registrant and Sidney D. Rosenblatt, dated as of February 7, 2007 (5)
10.9#	Non-Competition and Non-Solicitation Agreement between the registrant and Julia J. Brown, dated as of February 5, 2007 (5)
10.10#	Non-Competition and Non-Solicitation Agreement between the registrant and Janice K. Mahon, dated as of February 23, 2007 (4)
10.11#	Amended and Restated Change in Control Agreement between the registrant and Mauro Premutico, dated April 16, 2012 (6)
10.12#	Supplemental Executive Retirement Plan, dated as of April 1, 2010 (7)

Exhibit Number	Description
10.13#	Amended and Restated Equity Compensation Plan, effective as of March 7, 2013 (8)
10.14	1997 Amended License Agreement among the registrant, The Trustees of Princeton University and the University of Southern California, dated as of October 9, 1997 (9)
10.15	Amendment #1 to the Amended License Agreement among the registrant, the Trustees of Princeton University and the University of Southern California, dated as of August 7, 2003 (10)
10.16	Amendment #2 to the Amended License Agreement among the registrant, the Trustees of Princeton University, the University of Southern California and the Regents of the University of Michigan, dated as of January 1, 2006 (11)
10.17	Termination, Amendment and License Agreement by and among the registrant, PD-LD, Inc., Dr. Vladimir S. Ban, and The Trustees of Princeton University, dated as of July 19, 2000 (12)
10.18+	Amended and Restated OLED Materials Supply and Service Agreement between the registrant and PPG Industries, Inc., dated as of October 1, 2011 (13)
10.19+	OLED Patent License Agreement between the registrant and Samsung Display Co., Ltd., dated as of February 13, 2018 (14)
10.20+	Supplemental OLED Material Purchase Agreement between the registrant and Samsung Display Co., Ltd., dated as of February 13, 2018 (14)
10.21+	Patent Sale Agreement, dated as of July 23, 2012 by and between FUJIFILM Corporation and the Company (15)
10.22#	Universal Display Corporation Annual Incentive Plan (16)
10.23#	Form Agreement - Restricted Stock Unit Grant Letter (17)
10.24#	Form Agreement - Performance Unit Grant Letter (17)
10.25#	Universal Display Corporation Equity Compensation Plan (18)
10.26#	Amendment 2015-1, dated March 3, 2015, to Universal Display Corporation Supplemental Executive Retirement Plan (19)
10.27#	Equity Retention Agreement between the Registrant and Steven V. Abramson, dated April 7, 2015 (20)
10.28#	Equity Retention Agreement between the Registrant and Sidney D. Rosenblatt, dated April 7, 2015 (20)
10.29#	Equity Retention Agreement between the Registrant and Julia J. Brown, dated September 10, 2015 (21)
10.30#	Equity Retention Agreement between the Registrant and Mauro Premutico, dated September 10, 2015 (21)
10.31+	IP Transfer Agreement, dated June 28, 2016 by and between UDC Ireland Limited and BASF SE (22)
10.32#	Equity Grant Agreement between the registrant and Steven V. Abramson, dated as of December 12, 2019 (3)
10.33#	Equity Grant Agreement between the registrant and Sidney D. Rosenblatt, dated as of December 12, 2019 (3)
10.34#	Equity Grant Agreement between the registrant and Julia J. Brown, dated as of December 12, 2019 (3)
10.35#	Equity Grant Agreement between the registrant and Mauro Premutico, dated as of December 12, 2019 (3)
10.36#	Equity Grant Agreement between the registrant and Janice K. Mahon, dated as of December 12, 2019 (3)
21*	Subsidiaries of the registrant
23.1*	Consent of KPMG LLP
31.1*	Certifications of Steven V. Abramson, Chief Executive Officer, as required by Rule 13a-14(a) or Rule 15d-14(a)
31.2*	Certifications of Sidney D. Rosenblatt, Chief Financial Officer, as required by Rule 13a-14(a) or Rule 15d-14(a)
32.1**	Certifications of Steven V. Abramson, Chief Executive Officer, as required by Rule 13a-14(b) or Rule 15d-14(b), and by 18 U.S.C. Section 1350. (This exhibit shall not be deemed "filed" for purposes of Section 18 of the Securities Exchange Act of 1934, as amended, or otherwise subject to the liability of that section. Further, this exhibit shall not be deemed to be incorporated by reference into any filing under the Securities Act of 1933, as amended, or the Securities Exchange Act of 1934, as amended.)
32.2**	Certifications of Sidney D. Rosenblatt, Chief Financial Officer, as required by Rule 13a-14(b) or Rule 15d-14(b), and by 18 U.S.C. Section 1350. (This exhibit shall not be deemed "filed" for purposes of Section 18 of the Securities Exchange Act of 1934, as amended, or otherwise subject to the liability of that section. Further, this exhibit shall not be deemed to be incorporated by reference into any filing under the Securities Act of 1933, as amended, or the Securities Exchange Act of 1934, as amended.)

Exhibit Number	Description
101.INS*	Inline XBRL Instance Document – the instance document does not appear in the Interactive Data File because its XBRL tags are embedded within the Inline XBRL document
101.SCH*	Inline XBRL Taxonomy Extension Schema Document
101.CAL*	Inline XBRL Taxonomy Extension Calculation Linkbase Document
101.DEF*	Inline XBRL Taxonomy Extension Definition Linkbase Document
101.LAB*	Inline XBRL Taxonomy Extension Label Linkbase Document
101.PRE*	Inline XBRL Taxonomy Extension Presentation Linkbase Document
104	The cover page of this Annual Report on Form 10-K for the year ended December 31, 2020, formatted in Inline XBRL (included in Item 101.INS)

Explanation of footnotes to listing of exhibits:

* Filed herewith.

** Furnished herewith.

Management contract or compensatory plan or arrangement.

\+ Confidential treatment has been accorded to certain portions of this exhibit pursuant to Rule 406 under the Securities Act of 1933, as amended, or Rule 24b-2 under the Securities Exchange Act of 1934, as amended.

(1) Filed as an Exhibit to the Quarterly Report on Form 10-Q for the quarter ended June 30, 2018, filed with the SEC on August 9, 2018.

(2) Filed as an Exhibit to the Annual Report on Form 10-K for the year ended December 31, 2003, filed with the SEC on March 1, 2004.

(3) Filed as an Exhibit to the Annual Report on Form 10-K for the year ended December 31, 2019, filed with the SEC on February 20, 2020.

(4) Filed as an Exhibit to the Annual Report on Form 10-K for the year ended December 31, 2008, filed with the SEC on March 12, 2009.

(5) Filed as an Exhibit to the Annual Report on Form 10-K for the year ended December 31, 2006, filed with the SEC on March 15, 2007.

(6) Filed as an Exhibit to the Quarterly Report on Form 10-Q for the quarter ended June 30, 2012, filed with the SEC on August 8, 2012.

(7) Filed as an Exhibit to the Quarterly Report on Form 10-Q for the quarter ended March 31, 2010, filed with the SEC on May 10, 2010.

(8) Filed as an Exhibit to the Quarterly Report on Form 10-Q for the quarter ended March 31, 2013, filed with the SEC on May 9, 2013.

(9) Filed as an Exhibit to the Annual Report on Form 10K-SB for the year ended December 31, 1997, filed with the SEC on March 31, 1998.

(10) Filed as an Exhibit to the Quarterly Report on Form 10-Q for the quarter ended September 30, 2003, filed with the SEC on November 10, 2003.

(11) Filed as an Exhibit to the Quarterly Report on Form 10-Q for the quarter ended June 30, 2006, filed with the SEC on August 9, 2006.

(12) Filed as an Exhibit to the amended Quarterly Report on Form 10-Q for the quarter ended September 30, 2000, filed with the SEC on November 20, 2001.

(13) Filed as an Exhibit to the Quarterly Report on Form 10-Q for the quarter ended September 30, 2011, filed with the SEC on November 8, 2011.

(14) Filed as an Exhibit to the Quarterly Report on Form 10-Q for the quarter ended March 31, 2018, filed with the SEC on May 3, 2018.

(15) Filed as an Exhibit to a Current Report on Form 8-K, filed with the SEC on July 27, 2012.

(16) Filed as an Exhibit to a Current Report on Form 8-K, filed with the SEC on June 24, 2013.

(17) Filed as an Exhibit to the Annual Report on Form 10-K for the year ended December 31, 2013, filed with the SEC on February 28, 2014.

(18) Filed as Exhibit A to the Company's Definitive Proxy Statement for the 2014 Annual Meeting filed with the SEC on April 25, 2014.

(19) Filed as an exhibit to the Current Report on Form 8-K filed with the SEC on March 9, 2015.

(20) Filed as an Exhibit to the Quarterly Report on Form 10-Q for the quarter ended June 30, 2015, filed with the SEC on August 6, 2015.

(21) Filed as an Exhibit to the Quarterly Report on Form 10-Q for the quarter ended September 30, 2015, filed with the SEC on November 5, 2015.

(22) Filed as an Exhibit to the Quarterly Report on Form 10-Q for the quarter ended June 30, 2016, filed with the SEC on August 4, 2016.

Note: Any of the exhibits listed in the foregoing index not included with this report may be obtained, without charge, by writing to Mr. Sidney D. Rosenblatt, Corporate Secretary, Universal Display Corporation, 375 Phillips Boulevard, Ewing, New Jersey 08618.

(b) The exhibits required to be filed by us with this report are listed above.

(c) The Consolidated Financial Statement schedules required to be filed by us with this report are listed above.

ITEM 16. ***FORM 10-K SUMMARY***

None.

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, the registrant has duly caused this report to be signed on its behalf by the undersigned, thereunto duly authorized.

UNIVERSAL DISPLAY CORPORATION

By: /s/ Sidney D. Rosenblatt
Sidney D. Rosenblatt
Executive Vice President, Chief Financial Officer, Treasurer and Secretary

Date: February 18, 2021

Pursuant to the requirements of the Securities Exchange Act of 1934, this report has been signed below by the following persons on behalf of the registrant and in the capacities and on the dates indicated.

Name	Title	Date
/s/ Sherwin I. Seligsohn Sherwin I. Seligsohn	Founder and Chairman of the Board of Directors	February 18, 2021
/s/ Steven V. Abramson Steven V. Abramson	President, Chief Executive Officer and Director (principal executive officer)	February 18, 2021
/s/ Sidney D. Rosenblatt Sidney D. Rosenblatt	Executive Vice President, Chief Financial Officer, Treasurer, Secretary and Director (principal financial and accounting officer)	February 18, 2021
/s/ Cynthia J. Comparin Cynthia J. Comparin	Director	February 18, 2021
/s/ Richard C. Elias Richard C. Elias	Director	February 18, 2021
/s/ Elizabeth H. Gemmill Elizabeth H. Gemmill	Director	February 18, 2021
/s/ C. Keith Hartley C. Keith Hartley	Director	February 18, 2021
/s/ Celia M. Joseph Celia M. Joseph	Director	February 18, 2021
/s/ Lawrence Lacerte Lawrence Lacerte	Director	February 18, 2021

UNIVERSAL DISPLAY CORPORATION AND SUBSIDIARIES

INDEX TO CONSOLIDATED FINANCIAL STATEMENTS

Consolidated Financial Statements:

MANAGEMENT'S REPORT ON INTERNAL CONTROL OVER FINANCIAL REPORTING

Our management is responsible for establishing and maintaining adequate internal control over financial reporting for Universal Display Corporation and its subsidiaries (the Company). Internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of Consolidated Financial Statements for external purposes in accordance with generally accepted accounting principles. Our system of internal control over financial reporting includes those policies and procedures that (i) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the Company; (ii) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the Company are being made only in accordance with authorizations of management and directors of the Company; and (iii) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use or disposition of the Company's assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

Management performed an assessment of the effectiveness of our internal control over financial reporting as of December 31, 2020 based upon criteria in *Internal Control — Integrated Framework (2013)* issued by the Committee of Sponsoring Organizations of the Treadway Commission (COSO). Based on this assessment, management determined that the Company's internal control over financial reporting was effective as of December 31, 2020, based on the criteria in *Internal Control-Integrated Framework (2013)* issued by COSO.

The effectiveness of our internal control over financial reporting as of December 31, 2020, has been attested to by KPMG LLP, an independent registered public accounting firm, as stated in its report which appears on the following page.

Steven V. Abramson
President and Chief Executive Officer

Sidney D. Rosenblatt
Executive Vice President and Chief Financial Officer

February 18, 2021

REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Shareholders and Board of Directors
Universal Display Corporation:

Opinion on Internal Control Over Financial Reporting

We have audited Universal Display Corporation and subsidiaries' (the Company) internal control over financial reporting as of December 31, 2020, based on criteria established in *Internal Control – Integrated Framework (2013)* issued by the Committee of Sponsoring Organizations of the Treadway Commission. In our opinion, the Company maintained, in all material respects, effective internal control over financial reporting as of December 31, 2020, based on criteria established in *Internal Control – Integrated Framework (2013)* issued by the Committee of Sponsoring Organizations of the Treadway Commission.

We also have audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the consolidated balance sheets of the Company as of December 31, 2020 and 2019, the related consolidated statements of income, comprehensive income, shareholders' equity, and cash flows for each of the years in the three-year period ended December 31, 2020, and the related notes (collectively, the consolidated financial statements), and our report dated February 18, 2021 expressed an unqualified opinion on those consolidated financial statements.

Basis for Opinion

The Company's management is responsible for maintaining effective internal control over financial reporting and for its assessment of the effectiveness of internal control over financial reporting, included in the accompanying Management's Report on Internal Control over Financial Reporting. Our responsibility is to express an opinion on the Company's internal control over financial reporting based on our audit. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audit in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether effective internal control over financial reporting was maintained in all material respects. Our audit of internal control over financial reporting included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, and testing and evaluating the design and operating effectiveness of internal control based on the assessed risk. Our audit also included performing such other procedures as we considered necessary in the circumstances. We believe that our audit provides a reasonable basis for our opinion.

Definition and Limitations of Internal Control Over Financial Reporting

A company's internal control over financial reporting is a process designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of financial statements for external purposes in accordance with generally accepted accounting principles. A company's internal control over financial reporting includes those policies and procedures that (1) pertain to the maintenance of records that, in reasonable detail, accurately and fairly reflect the transactions and dispositions of the assets of the company; (2) provide reasonable assurance that transactions are recorded as necessary to permit preparation of financial statements in accordance with generally accepted accounting principles, and that receipts and expenditures of the company are being made only in accordance with authorizations of management and directors of the company; and (3) provide reasonable assurance regarding prevention or timely detection of unauthorized acquisition, use, or disposition of the company's assets that could have a material effect on the financial statements.

Because of its inherent limitations, internal control over financial reporting may not prevent or detect misstatements. Also, projections of any evaluation of effectiveness to future periods are subject to the risk that controls may become inadequate because of changes in conditions, or that the degree of compliance with the policies or procedures may deteriorate.

/s/ KPMG LLP

Philadelphia, Pennsylvania
February 18, 2021

REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Shareholders and Board of Directors
Universal Display Corporation:

Opinion on the Consolidated Financial Statements

We have audited the accompanying consolidated balance sheets of Universal Display Corporation and subsidiaries (the Company) as of December 31, 2020 and 2019, the related consolidated statements of income, comprehensive income, shareholders' equity, and cash flows for each of the years in the three-year period ended December 31, 2020, and the related notes (collectively, the consolidated financial statements). In our opinion, the consolidated financial statements present fairly, in all material respects, the financial position of the Company as of December 31, 2020 and 2019, and the results of its operations and its cash flows for each of the years in the three-year period ended December 31, 2020, in conformity with U.S. generally accepted accounting principles.

We also have audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the Company's internal control over financial reporting as of December 31, 2020, based on criteria established in Internal Control – Integrated Framework (2013) issued by the Committee of Sponsoring Organizations of the Treadway Commission, and our report dated February 18, 2021 expressed an unqualified opinion on the effectiveness of the Company's internal control over financial reporting.

Change in Accounting Principle

As discussed in Notes 2 and 8 to the consolidated financial statements, the Company has changed its method of accounting for leases as of January 1, 2019 due to the adoption of Financial Accounting Standards Board (FASB) Accounting Standards Codification (ASC) Topic 842, Leases. In addition, as discussed in Note 19 to the consolidated financial statements, the Company changed its method for accounting for revenue from contracts with customers as of January 1, 2018 due to the adoption of FASB ASC Topic 606, Revenue from Contracts with Customers.

Basis for Opinion

These consolidated financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on these consolidated financial statements based on our audits. We are a public accounting firm registered with the PCAOB and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the consolidated financial statements are free of material misstatement, whether due to error or fraud. Our audits included performing procedures to assess the risks of material misstatement of the consolidated financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the consolidated financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the consolidated financial statements. We believe that our audits provide a reasonable basis for our opinion.

Critical Audit Matter

The critical audit matter communicated below is a matter arising from the current period audit of the consolidated financial statements that was communicated or required to be communicated to the audit committee and that: (1) relates to accounts or disclosures that are material to the consolidated financial statements and (2) involved our especially challenging, subjective, or complex judgments. The communication of a critical audit matter does not alter in any way our opinion on the consolidated financial statements, taken as a whole, and we are not, by communicating the critical audit matter below, providing separate opinions on the critical audit matter or on the accounts or disclosures to which it relates.

Estimated per unit fee for long-term OLED contracts

As discussed in Notes 2 and 19 to the consolidated financial statements, the Company recognizes revenue for organic light emitting diode (OLED) sales to customers with long-term contracts (i.e., over 1 year in length) using certain estimates. Revenue is determined by estimating total contract consideration expected to be received over the term of the contract and recognized based on material units sold during the period at their estimated per unit fee. The estimated per unit fee includes fixed amounts designated in contracts with customers as license fees, as well as estimates of material units to be sold and royalties to be earned.

The Company uses internal and external data to estimate material units to be sold and royalty consideration to be received over the contract terms.

We identified the assessment of the estimated per unit fee for long-term OLED contracts as a critical audit matter. The estimated per unit fee was dependent upon the estimates of total material units to be sold and royalties to be earned. Significant auditor judgment was required in evaluating the forecasted material unit sales and royalties, as changes in the estimates could significantly affect the estimated per unit fee.

The following are the primary procedures we performed to address this critical audit matter. We evaluated the design and tested the operating effectiveness of certain internal controls related to the critical audit matter. This included controls related to the Company's revenue recognition process, including the Company's review and approval of forecasted quantities of material unit sales of OLED products and review of forecasted royalties. We assessed the Company's forecasting policies and procedures and the inputs used in making the estimates by considering other reasonably likely outcomes when evaluating potential management bias. Additionally, we inspected the forecast calculations for a selection of OLED contracts and compared the per-material unit prices and royalty rates used against the respective contract terms. We compared the OLED material unit sales forecast to internal operating and production budgets, and we compared the forecasted OLED material unit sales and royalties to the results of inquiries of Company personnel, publicly available market data, and analyst reports. We assessed the Company's ability to accurately forecast OLED material unit sales and royalties by comparing recent historical forecasts to actual results and evaluating the Company's conclusions regarding the reasons for changes in the current year's estimates as compared to prior estimates.

/s/ KPMG LLP

We have served as the Company's auditor since 2002.

Philadelphia, Pennsylvania
February 18, 2021

UNIVERSAL DISPLAY CORPORATION AND SUBSIDIARIES

CONSOLIDATED BALANCE SHEETS

(in thousands, except share and per share data)

	December 31, 2020	December 31, 2019
ASSETS		
CURRENT ASSETS:		
Cash and cash equivalents	$ 630,012	$ 131,627
Short-term investments	99,996	514,461
Accounts receivable	82,261	60,452
Inventory	91,591	63,953
Other current assets	20,746	21,946
Total current assets	924,606	792,439
PROPERTY AND EQUIPMENT, net of accumulated depreciation of $72,493 and $57,276	102,113	87,872
ACQUIRED TECHNOLOGY, net of accumulated amortization of $153,050 and $132,468	70,253	90,774
OTHER INTANGIBLE ASSETS, net of accumulated amortization of $6,155 and $4,768	10,685	12,072
GOODWILL	15,535	15,535
INVESTMENTS	5,000	5,000
DEFERRED INCOME TAXES	37,695	30,375
OTHER ASSETS	103,341	86,090
TOTAL ASSETS	$ 1,269,228	$ 1,120,157
LIABILITIES AND SHAREHOLDERS' EQUITY		
CURRENT LIABILITIES:		
Accounts payable	$ 13,801	$ 13,296
Accrued expenses	41,404	49,022
Deferred revenue	105,215	97,333
Other current liabilities	4,540	1,857
Total current liabilities	164,960	161,508
DEFERRED REVENUE	57,086	47,529
RETIREMENT PLAN BENEFIT LIABILITY	78,527	51,117
OTHER LIABILITIES	55,941	48,554
Total liabilities	356,514	308,708
COMMITMENTS AND CONTINGENCIES (Note 16)		
SHAREHOLDERS' EQUITY:		
Preferred Stock, par value $0.01 per share, 5,000,000 shares authorized, 200,000 shares of Series A Nonconvertible Preferred Stock issued and outstanding (liquidation value of $7.50 per share or $1,500)	2	2
Common Stock, par value $0.01 per share, 200,000,000 shares authorized, 49,013,476 and 48,852,193 shares issued, and 47,647,828 and 47,486,545 shares outstanding at December 31, 2020 and December 31, 2019, respectively	490	489
Additional paid-in capital	635,595	620,236
Retained earnings	353,930	249,003
Accumulated other comprehensive loss	(36,019)	(16,997)
Treasury stock, at cost (1,365,648 shares at December 31, 2020 and December 31, 2019)	(41,284)	(41,284)
Total shareholders' equity	912,714	811,449
TOTAL LIABILITIES AND SHAREHOLDERS' EQUITY	$ 1,269,228	$ 1,120,157

The accompanying notes are an integral part of these Consolidated Financial Statements.

UNIVERSAL DISPLAY CORPORATION AND SUBSIDIARIES

CONSOLIDATED STATEMENTS OF INCOME

(in thousands, except share and per share data)

	Year Ended December 31,		
	2020	2019	2018
REVENUE:			
Material sales	$ 229,749	$ 243,413	$ 153,204
Royalty and license fees	185,054	150,022	80,644
Contract research services	14,064	11,742	13,566
Total revenue	428,867	405,177	247,414
COST OF SALES	85,478	75,374	53,541
Gross margin	343,389	329,803	193,873
OPERATING EXPENSES:			
Research and development	83,894	71,276	53,717
Selling, general and administrative	61,346	59,613	46,999
Amortization of acquired technology and other intangible assets	21,969	21,962	21,962
Patent costs	7,529	6,833	7,464
Royalty and license expense	11,125	11,776	6,996
Total operating expenses	185,863	171,460	137,138
OPERATING INCOME	157,526	158,343	56,735
Interest income, net	5,139	10,795	7,659
Other income (expense), net	864	767	(83)
Interest and other income, net	6,003	11,562	7,576
INCOME BEFORE INCOME TAXES	163,529	169,905	64,311
INCOME TAX EXPENSE	(30,157)	(31,601)	(5,471)
NET INCOME	$ 133,372	$ 138,304	$ 58,840
NET INCOME PER COMMON SHARE:			
BASIC	$ 2.80	$ 2.92	$ 1.24
DILUTED	$ 2.80	$ 2.92	$ 1.24
WEIGHTED AVERAGE SHARES USED IN COMPUTING NET INCOME PER COMMON SHARE:			
BASIC	47,198,982	46,959,775	46,849,588
DILUTED	47,236,994	46,995,462	46,896,766
CASH DIVIDEND DECLARED PER COMMON SHARE	$ 0.60	$ 0.40	$ 0.24

The accompanying notes are an integral part of these Consolidated Financial Statements.

UNIVERSAL DISPLAY CORPORATION AND SUBSIDIARIES

CONSOLIDATED STATEMENTS OF COMPREHENSIVE INCOME

(in thousands)

	Year Ended December 31,		
	2020	2019	2018
NET INCOME	$ 133,372	$ 138,304	$ 58,840
OTHER COMPREHENSIVE (LOSS) INCOME, NET OF TAX:			
Unrealized (loss) gain on available-for-sale securities, net of tax of $28, $51 and $74, respectively	(100)	181	268
Employee benefit plan:			
Actuarial loss on retirement plan, net of tax of $3,569, $988 and $1,841, respectively	(21,464)	(3,492)	(6,690)
Amortization of prior service cost and actuarial loss for retirement plan included in net periodic pension costs, net of tax of $723, $713 and $457, respectively	2,556	2,523	1,661
Net change in employee benefit plan	(18,908)	(969)	(5,029)
Change in cumulative foreign currency translation adjustment	(14)	25	(9)
TOTAL OTHER COMPREHENSIVE LOSS	(19,022)	(763)	(4,770)
COMPREHENSIVE INCOME	$ 114,350	$ 137,541	$ 54,070

The accompanying notes are an integral part of these Consolidated Financial Statements.

CONSOLIDATED STATEMENTS OF SHAREHOLDERS' EQUITY

(in thousands, except for share data)

	Series A Nonconvertible Preferred Stock		Common Stock		Additional Paid-in Capital	Retained Earnings	Accumulated Other Comprehensive Loss	Treasury Stock		Total Shareholders' Equity
	Shares	Amount	Shares	Amount				Shares	Amount	
BALANCE, DECEMBER 31, 2017	200,000	$ 2	48,476,034	$ 485	$ 611,063	$ 99,126	$ (11,464)	1,357,863	$ (40,158)	$ 659,054
ASC Topic 606 Adoption	—	—	—	—	—	(17,100)	—	—	—	(17,100)
ADJUSTED BALANCE, JANUARY 1, 2018	200,000	2	48,476,034	485	611,063	82,026	(11,464)	1,357,863	(40,158)	641,954
Net income	—	—	—	—	—	58,840	—	—	—	58,840
Other comprehensive loss	—	—	—	—	—	—	(4,770)	—	—	(4,770)
Cash dividend	—	—	—	—	—	(11,314)	—	—	—	(11,314)
Issuance of common stock to employees	—	—	271,068	3	12,136	—	—	—	—	12,139
Shares withheld for employee taxes	—	—	(108,113)	(1)	(11,619)	—	—	—	—	(11,620)
Common shares repurchased	—	—	—	—	—	—	—	3,774	(477)	(477)
Issuance of common stock to Board of Directors and Scientific Advisory Board	—	—	32,232	—	4,664	—	—	—	—	4,664
Issuance of common stock to employees under an ESPP	—	—	10,303	—	1,090	—	—	—	—	1,090
BALANCE, DECEMBER 31, 2018	200,000	2	48,681,524	487	617,334	129,552	(16,234)	1,361,637	(40,635)	690,506
Net income	—	—	—	—	—	138,304	—	—	—	138,304
Other comprehensive loss	—	—	—	—	—	—	(763)	—	—	(763)
Cash dividend	—	—	—	—	—	(18,853)	—	—	—	(18,853)
Issuance of common stock to employees	—	—	247,776	2	15,875	—	—	—	—	15,877
Shares withheld for employee taxes	—	—	(99,099)	—	(15,980)	—	—	—	—	(15,980)
Common shares repurchased	—	—	—	—	—	—	—	4,011	(649)	(649)
Issuance of common stock to Board of Directors and Scientific Advisory Board	—	—	14,500	—	1,848	—	—	—	—	1,848
Issuance of common stock to employees under an ESPP	—	—	7,492	—	1,159	—	—	—	—	1,159
BALANCE, DECEMBER 31, 2019	200,000	2	48,852,193	489	620,236	249,003	(16,997)	1,365,648	(41,284)	811,449
Net income	—	—	—	—	—	133,372	—	—	—	133,372
Other comprehensive loss	—	—	—	—	—	—	(19,022)	—	—	(19,022)
Cash dividend	—	—	—	—	—	(28,445)	—	—	—	(28,445)
Issuance of common stock to employees	—	—	240,414	2	26,282	—	—	—	—	26,284
Shares withheld for employee taxes	—	—	(99,319)	(1)	(14,393)	—	—	—	—	(14,394)
Issuance of common stock to Board of Directors and Scientific Advisory Board	—	—	10,520	—	1,947	—	—	—	—	1,947
Issuance of common stock to employees under an ESPP	—	—	9,668	—	1,523	—	—	—	—	1,523
BALANCE, DECEMBER 31, 2020	200,000	$ 2	49,013,476	$ 490	$ 635,595	$ 353,930	$ (36,019)	1,365,648	$ (41,284)	$ 912,714

The accompanying notes are an integral part of these Consolidated Financial Statements.

UNIVERSAL DISPLAY CORPORATION AND SUBSIDIARIES

CONSOLIDATED STATEMENTS OF CASH FLOWS

(in thousands)

	Year Ended December 31,		
	2020	**2019**	**2018**
CASH FLOWS FROM OPERATING ACTIVITIES:			
Net income	$ 133,372	$ 138,304	$ 58,840
Adjustments to reconcile net income to net cash provided by operating activities:			
Amortization of deferred revenue and recognition of unbilled receivables	(183,997)	(135,368)	(68,905)
Depreciation	15,217	12,456	8,612
Amortization of intangibles	21,969	21,962	21,962
Change in excess inventory reserve	1,114	5,938	3,630
Amortization of premium and discount on investments, net	(4,960)	(6,643)	(6,131)
Stock-based compensation to employees	26,631	16,148	12,432
Stock-based compensation to Board of Directors and Scientific Advisory Board	1,647	1,548	4,364
Deferred income tax benefit	(4,446)	(5,776)	(12,814)
Retirement plan expense	5,656	5,818	4,466
Decrease (increase) in assets:			
Accounts receivable	(21,809)	(17,323)	9,226
Inventory	(28,752)	109	(37,365)
Other current assets	6,497	(15,238)	4,860
Deferred income taxes	—	—	20,682
Other assets	(13,481)	(13,291)	(63,922)
Increase (decrease) in liabilities:			
Accounts payable and accrued expenses	(8,305)	15,516	1,563
Other current liabilities	2,683	(5,183)	5,761
Deferred revenue	192,369	157,321	130,639
Other liabilities	7,387	17,614	23,896
Net cash provided by operating activities	148,792	193,912	121,796
CASH FLOWS FROM INVESTING ACTIVITIES:			
Purchases of property and equipment	(27,991)	(30,059)	(25,391)
Purchase of intangibles	(60)	(401)	—
Purchases of investments	(604,153)	(931,854)	(628,789)
Proceeds from sale and maturity of investments	1,023,460	723,600	633,179
Net cash provided by (used in) investing activities	391,256	(238,714)	(21,001)
CASH FLOWS FROM FINANCING ACTIVITIES:			
Proceeds from issuance of common stock	1,176	889	798
Repurchase of common stock	—	(649)	(477)
Payment of withholding taxes related to stock-based compensation to employees	(14,394)	(15,980)	(11,620)
Cash dividends paid	(28,445)	(18,853)	(11,314)
Net cash used in financing activities	(41,663)	(34,593)	(22,613)
INCREASE (DECREASE) IN CASH AND CASH EQUIVALENTS	498,385	(79,395)	78,182
CASH AND CASH EQUIVALENTS, BEGINNING OF YEAR	131,627	211,022	132,840
CASH AND CASH EQUIVALENTS, END OF YEAR	$ 630,012	$ 131,627	$ 211,022
The following non-cash activities occurred:			
Unrealized (loss) gain on available-for-sale securities	$ (118)	$ 241	$ 342
Common stock issued to Board of Directors and Scientific Advisory Board that was earned and accrued for in a previous period	300	300	300
Net change in accounts payable and accrued expenses related to purchases of property and equipment	(1,468)	(530)	3,490
Cash paid for income tax	36,269	46,602	17,771

The accompanying notes are an integral part of these Consolidated Financial Statements.

1. BUSINESS:

Universal Display Corporation and its subsidiaries (the Company) is a leader in the research, development and commercialization of organic light emitting diode (OLED) technologies and materials for use in display and solid-state lighting applications. OLEDs are thin, lightweight and power-efficient solid-state devices that emit light that can be manufactured on both flexible and rigid substrates, making them highly suitable for use in full-color displays and as lighting products. OLED displays are capturing a growing share of the display market, especially in the mobile phone, television, wearable, tablet, notebook and personal computer, augmented reality (AR), virtual reality (VR) and automotive markets. The Company believes this is because OLEDs offer potential advantages over competing display technologies with respect to power efficiency, contrast ratio, viewing angle, video response time, form factor and manufacturing cost. The Company also believes that OLED lighting products have the potential to replace many existing light sources in the future because of their high-power efficiency, excellent color rendering index, low operating temperature and novel form factor. The Company's technology leadership, intellectual property position, and the Company's more than 20 years of experience working closely with leading OLED display manufacturers are some of the competitive advantages that should enable the Company to continue to share in the revenues from OLED displays and lighting products as they gain wider acceptance.

The Company's primary business strategy is to (1) develop new OLED materials and sell existing and any new materials to manufacturers of products for display applications, such as mobile phones, televisions, wearables, tablets, portable media devices, notebook computers, personal computers and automotive applications, and specialty and general lighting products; and (2) further develop and license the Company's proprietary OLED technologies to those manufacturers. The Company has established a significant portfolio of proprietary OLED technologies and materials, primarily through internal research and development efforts and acquisitions of patents and patent applications, as well as maintaining long-standing, and establishing new relationships with world-class universities, research institutions and strategic manufacturing partnerships. The Company currently owns, exclusively licenses or has the sole right to sublicense more than 5,000 patents issued and pending worldwide.

The Company manufactures and sells its proprietary OLED materials to customers for evaluation and use in commercial OLED products. The Company also enters into agreements with manufacturers of OLED display and lighting products under which it grants them licenses to practice under the Company's patents and to use the Company's proprietary know-how. At the same time, the Company works with these and other companies that are evaluating the Company's OLED technologies and materials for possible use in commercial OLED display and lighting products.

2. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES:

Principles of Consolidation

The Consolidated Financial Statements include the accounts of Universal Display Corporation and its wholly owned subsidiaries, UDC, Inc., UDC Ireland Limited (UDC Ireland), Universal Display Corporation Hong Kong, Limited, Universal Display Corporation Korea, Y.H., Universal Display Corporation Japan GK, Universal Display Corporation China, Ltd., Adesis, Inc. (Adesis), UDC Ventures LLC and OVJP Corporation (OVJP Corp). All intercompany transactions and accounts have been eliminated.

In June 2020, a wholly-owned subsidiary, OVJP Corp, was formed as a Delaware corporation. Based out of California, OVJP Corp was founded to advance the commercialization of the Company's proprietary Organic Vapor Jet Printing (OVJP) technology.

Management's Use of Estimates

The preparation of financial statements in conformity with U.S. generally accepted accounting principles (GAAP) requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the reporting period. The estimates made are principally in the areas of revenue recognition including estimates of material unit sales and royalties, the useful life of acquired intangibles, lease liabilities, right-of-use assets, the use and recoverability of inventories, intangibles, investments and income taxes including realization of deferred tax assets, stock-based compensation and retirement benefit plan liabilities. Actual results could differ from those estimates.

Cash and Cash Equivalents

The Company considers all highly liquid debt instruments purchased with an original maturity (maturity at the purchase date) of three months or less to be cash equivalents. The Company classifies its remaining investments as available-for-sale. These securities

are carried at fair market value, with unrealized gains and losses reported in shareholders' equity. Gains or losses on securities sold are based on the specific identification method.

Trade Accounts Receivable

Trade accounts receivable are stated at the amount the Company expects to collect and do not bear interest. The Company considers the following factors when determining the collectability of specific customer accounts: customer credit-worthiness, past transaction history with the customer, current economic industry trends, and changes in customer payment terms. The Company's accounts receivable balance is a result of chemical sales, royalties and license fees. These receivables have historically been paid timely. Due to the nature of the accounts receivable balance, the Company believes there is no significant risk of collection. If the financial condition of the Company's customers were to deteriorate, adversely affecting their ability to make payments, allowances for credit losses would be required. The allowance for credit losses was $139,000, $84,000 and $77,000 at December 31, 2020, 2019 and 2018, respectively.

Inventories

Inventories consist of raw materials, work-in-process and finished goods, including inventory consigned to customers, and are stated at the lower of cost, determined on a first-in, first-out basis, or net realizable value. Inventory valuation and firm committed purchase order assessments are performed on a quarterly basis and those items that are identified to be obsolete or in excess of forecasted usage are written down to their estimated realizable value. Estimates of realizable value are based upon management's analyses and assumptions, including, but not limited to, forecasted sales levels by product, expected product lifecycle, product development plans and future demand requirements. A 12-month rolling forecast based on factors, including, but not limited to, production cycles, anticipated product orders, marketing forecasts, backlog, and shipment activities is used in the inventory analysis. If market conditions are less favorable than forecasts or actual demand from customers is lower than estimates, additional inventory write-downs may be required. If demand is higher than expected, inventories that had previously been written down may be sold.

Property and Equipment

Property and equipment are stated at cost and depreciated on a straight-line basis over the estimated useful life of 30 years for building, 15 years for building improvements, and three to seven years for office and lab equipment and furniture and fixtures. Repair and maintenance costs are charged to expense as incurred. Additions and betterments are capitalized.

Major renewals and improvements are capitalized and minor replacements, maintenance, and repairs are charged to current operations as incurred. Upon retirement or disposal of assets, the cost and related accumulated depreciation are removed from the Consolidated Balance Sheets and any gain or loss is reflected in other operating expenses.

Certain costs of computer software obtained for internal use are capitalized and amortized on a straight-line basis over three years. Costs for maintenance and training, as well as the cost of software that does not add functionality to an existing system, are expensed as incurred.

Impairment of Long-Lived Assets

Company management continually evaluates whether events or changes in circumstances might indicate that the remaining estimated useful life of long-lived assets may warrant revision, or that the remaining balance may not be recoverable. When factors indicate that long-lived assets should be evaluated for possible impairment, the Company uses an estimate of the related undiscounted cash flows in measuring whether the long-lived asset should be written down to fair value. Measurement of the amount of impairment would be based on generally accepted valuation methodologies, as deemed appropriate. As of December 31, 2020, Company management believed that no revision to the remaining useful lives or write-down of the Company's long-lived assets was required, and similarly, no such revisions were required for the years ended December 31, 2019 or 2018.

Goodwill and Purchased Intangible Assets

Goodwill is tested for impairment in the fourth fiscal quarter and, when specific circumstances dictate, between annual tests. Company management first assesses qualitative factors to determine whether it is more likely than not that the fair value of a reporting unit is less than its carrying amount as a basis for determining whether a quantitative goodwill impairment test is necessary. If it is concluded it is more likely than not that the fair value of a reporting unit exceeds its carrying amount, then a quantitative impairment assessment is not necessary. If it is determined that goodwill has been impaired, then its carrying value is written down to fair value. The goodwill impairment test involves a two-step process. The first step, identifying a potential impairment, compares the fair value of a reporting unit with its carrying amount, including goodwill. If the carrying value of the reporting unit exceeds its fair value, the second step would need to be conducted; otherwise, no further steps are necessary as no potential impairment exists. If necessary, the

second step to measure the impairment loss would be to compare the implied fair value of the reporting unit goodwill with the carrying amount of that goodwill. Any excess of the reporting unit goodwill carrying value over the respective implied fair value is recognized as an impairment loss. The Company performed its annual impairment assessment as of December 31, 2020 utilizing a qualitative evaluation and concluded that it was more likely than not that the fair value of Adesis is greater than its carrying value. Company management believes it has made reasonable estimates and assumptions to calculate the fair value of the reporting unit. Future impairment tests will continue to be performed annually in the fiscal fourth quarter, or sooner if a triggering event occurs. As of December 31, 2020, no indications of impairment existed.

Purchased intangible assets with finite lives are carried at cost, less accumulated amortization. Amortization is computed over the estimated useful lives of the respective assets.

Fair Value of Financial Instruments

The carrying values of accounts receivable, other current assets, and accounts payable approximate fair value in the accompanying financial statements due to the short-term nature of those instruments. The Company's other financial instruments, which include cash equivalents and investments, are carried at fair value.

Fair Value Measurements

Fair value is defined as an exit price, representing the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants based on the highest and best use of the asset or liability. The Company uses valuation techniques to measure fair value that maximize the use of observable inputs and minimize the use of unobservable inputs. Observable inputs are inputs that market participants would use in pricing the asset or liability and are based on market data obtained from sources independent of the Company. Unobservable inputs reflect assumptions market participants would use in pricing the asset or liability based on the best information available in the circumstances

Minority Equity Investments

The Company accounts for minority equity investments in companies that are not accounted for under the equity method as equity securities without readily determinable fair values. The fair values of these securities is based on original cost less impairments, if any, plus or minus changes resulting from observable price changes in orderly transactions for the identical or similar investment of the same issuer. Under this method, the share of income or loss of such companies is not included in the Consolidated Statements of Income. The carrying value of these investments is included in investments on the Consolidated Balance Sheets.

The Company's policy is to recognize an impairment in the value of its minority equity investments when evidence of an impairment exists. Factors considered in the assessment include a significant adverse change in the regulatory, economic, or technological environment, the completion of new equity financing that may indicate a decrease in value, the failure to complete new equity financing arrangements after seeking to raise additional funds, or the commencement of proceedings under which the assets of the business may be placed in receivership or liquidated to satisfy claims of debt and equity stakeholders.

Leases

The Company is a lessee in operating leases primarily incurred to facilitate the expansion of manufacturing, research and development, and selling, general and administrative activities. As discussed in Note 8, effective January 1, 2019, the Company accounts for leases in accordance with Financial Accounting Standards Board (FASB) Accounting Standards Codification (ASC) Topic 842, *Leases*. At contract inception, the Company determines if an arrangement is or contains a lease, and if so recognizes a right-of-use asset and lease liability at the lease commencement date. For operating leases, the lease liability is measured at the present value of the unpaid lease payments at the lease commencement date, whereas for finance leases, the lease liability is initially measured at the present value of the unpaid lease payments and subsequently measured at amortized cost using the interest method. Operating lease right-of-use assets are included in other assets on the Consolidated Balance Sheets. The short-term portion of operating lease liabilities is included in other current liabilities on the Consolidated Balance Sheets and the long-term portion is included in other liabilities on the Consolidated Balance Sheets. As of December 31, 2020, the Company had no leases that qualified as financing arrangements.

Key estimates and judgements include how the Company determines the discount rate used to discount the unpaid lease payments to present value and the lease term. The Company monitors for events or changes in circumstances that could potentially require recognizing an impairment loss.

Revenue Recognition and Deferred Revenue

Material sales relate to the Company's sale of its OLED materials for incorporation into its customers' commercial OLED products or for their OLED development and evaluation activities. Revenue associated with material sales is generally recognized at the time title passes, which is typically at the time of shipment or at the time of delivery, depending upon the contractual agreement between the parties. Revenue may be recognized after control of the material passes in the event the transaction price includes variable consideration. For example, a customer may be provided an extended opportunity to stock materials prior to use in mass production and given a general right of return not conditioned on breaches of warranties associated with the specific product. In such circumstances, revenue will be recognized at the earlier of the expiration of the customer's general right of return or once it becomes unlikely that the customer will exercise its right of return.

The rights and benefits to the Company's OLED technologies are conveyed to the customer through technology license agreements and material supply agreements. The Company believes that the licenses and materials sold under these combined agreements are not distinct from each other for financial reporting purposes and as such, are accounted for as a single performance obligation. Accordingly, total contract consideration, including material, license and royalty fees, is estimated and recognized over the contract term based on material units sold at the estimated per unit fee over the life of the contract.

Various estimates are relied upon to recognize revenue. The Company estimates total material units to be purchased by its customers over the contract term based on historical trends, industry estimates and its forecast process. Management uses the expected value method to estimate the material per unit fee. Additionally, management estimates the total sales-based royalties based on the estimated net sales revenue of its customers over the contract term.

Contract research services revenue is revenue earned by Adesis by providing chemical materials synthesis research, development and commercialization for non-OLED applications on a contractual basis. These services range from intermediates for structure-activity relationship studies, reference agents and building blocks for combinatorial synthesis, re-synthesis of key intermediates, specialty organic chemistry needs, and selective toll manufacturing. These services are provided to third-party pharmaceutical and life sciences firms and other technology firms at fixed costs or on an annual contract basis. Revenue is recognized as services are performed with billing schedules and payment terms negotiated on a contract-by-contract basis. Payments received in excess of revenue recognized are recorded as deferred revenue. In other cases, services may be provided and revenue is recognized before the customer is invoiced. In these cases, revenue recognized will exceed amounts billed and the difference, representing amounts which are currently unbillable to the customer pursuant to contractual terms, is recorded as an unbilled receivable.

Technology development and support revenue is revenue earned from development and technology evaluation agreements and commercialization assistance fees, along with, to a minimal extent, government contracts. Relating to the Company's government contracts, the Company may receive reimbursements by government entities for all or a portion of the research and development costs the Company incurs. Revenues are recognized as services are performed, proportionally as research and development costs are incurred, or as defined milestones are achieved.

In 2018, the Company entered into a commercial patent license agreement with Samsung Display Co., Ltd. (SDC). This agreement, which covers the manufacture and sale of specified OLED display materials, was effective as of January 1, 2018 and lasts through the end of 2022 with an additional two-year extension option. Under this agreement, the Company is being paid a license fee, payable in quarterly installments over the agreement term of five years. The agreement conveys to SDC the non-exclusive right to use certain of the Company's intellectual property assets for a limited period of time that is less than the estimated life of the assets.

At the same time the Company entered into the current license agreement with SDC, the Company also entered into a new supplemental material purchase agreement with SDC. Under the supplemental material purchase agreement, SDC agrees to purchase from the Company a minimum amount of phosphorescent emitter materials for use in the manufacture of licensed products. This minimum commitment is subject to SDC's requirements for phosphorescent emitter materials and the Company's ability to meet these requirements over the term of the supplemental agreement.

In 2015, the Company entered into an OLED patent license agreement and an OLED commercial supply agreement with LG Display Co., Ltd. (LG Display) which were effective as of January 1, 2015 and superseded the existing 2007 commercial supply agreement between the parties. The new agreements have a term that is set to expire by the end of 2022. The patent license agreement provides LG Display a non-exclusive, royalty bearing portfolio license to make and sell OLED displays under the Company's patent portfolio. The patent license calls for license fees, prepaid royalties and running royalties on licensed products. The agreements include customary provisions relating to warranties, indemnities, confidentiality, assignability and business terms. The agreements provide for certain other minimum obligations relating to the volume of material sales anticipated over the life of the agreements as well as minimum royalty revenue to be generated under the patent license agreement. The Company generates revenue under these agreements that are predominantly tied to LG Display's sales of OLED licensed products. The OLED commercial supply agreement provides for the sale of materials for use by LG Display, which may include phosphorescent emitters and host materials.

In 2016, the Company entered into long-term, multi-year OLED patent license and material purchase agreements with Tianma Micro-electronics Co., Ltd. (Tianma). Under the license agreement, the Company has granted Tianma non-exclusive license rights under various patents owned or controlled by the Company to manufacture and sell OLED display products. The license agreement calls for license fees and running royalties on licensed products. Additionally, the Company supplies phosphorescent OLED materials to Tianma for use in its licensed products.

In 2017, the Company entered into long-term, multi-year agreements with BOE Technology Group Co., Ltd. (BOE). Under these agreements, the Company has granted BOE non-exclusive license rights under various patents owned or controlled by the Company to manufacture and sell OLED display products. The Company supplies phosphorescent OLED materials to BOE for use in its licensed products.

In 2018, the Company entered into long-term, multi-year OLED patent license and material purchase agreements with Visionox Technology, Inc. (Visionox). Under the license agreement, the Company has granted Visionox non-exclusive license rights under various patents owned or controlled by the Company to manufacture and sell OLED display products. The license agreement calls for license fees and running royalties on licensed products. Additionally, the Company supplies phosphorescent OLED materials to Visionox for use in its licensed products.

In 2019, the Company entered into an evaluation and commercial supply relationship with Wuhan China Star Optoelectronics Semiconductor Display Technology Co., Ltd. (CSOT). In 2020, the Company entered into long-term, multi-year agreements with CSOT. Under these agreements, the Company has granted CSOT non-exclusive license rights under various patents owned or controlled by the Company to manufacture and sell OLED display products. The Company also supplies phosphorescent OLED materials to CSOT for use in licensed products.

All material sales transactions that are not variable consideration transactions are billed and due within 90 days and substantially all are transacted in U.S. dollars.

Cost of Sales

Cost of sales consists of labor and material costs associated with the production of materials processed at the Company's manufacturing partners and at the Company's internal manufacturing processing facility. The Company’s portion of cost of sales also includes depreciation of manufacturing equipment, as well as manufacturing overhead costs and inventory adjustments for excess and obsolete inventory.

Research and Development

Expenditures for research and development are charged to operations as incurred.

Patent Costs

Costs associated with patent applications, patent prosecution, patent defense and the maintenance of patents are charged to expense as incurred. Costs to successfully defend a challenge to a patent are capitalized to the extent of an evident increase in the value of the patent. Costs that relate to an unsuccessful outcome are charged to expense.

Amortization of Acquired Technology

Amortization costs primarily relate to technology acquired from BASF and Fujifilm. These acquisitions were completed in the years ended December 31, 2016 and 2012, respectively. Acquisition costs are being amortized over a period of 10 years for both the BASF and Fujifilm patents.

Amortization of Other Intangible Assets

Other intangible assets from the Adesis acquisition are being amortized over a period of 10 to 15 years. See Note 7 for further discussion.

Translation of Foreign Currency Financial Statements and Foreign Currency Transactions

The Company's reporting currency is the U.S. dollar. The functional currency for the Company's Ireland subsidiary is also the U.S. dollar and the functional currency for each of the Company's Asia-Pacific foreign subsidiaries is its local currency. The Company translates the amounts included in the Consolidated Statements of Income from its Asia-Pacific foreign subsidiaries into U.S. dollars

at weighted-average exchange rates, which the Company believes are representative of the actual exchange rates on the dates of the transactions. The Company's foreign subsidiaries' assets and liabilities are translated into U.S. dollars from the local currency at the actual exchange rates as of the end of each reporting date, and the Company records the resulting foreign exchange translation adjustments in the Consolidated Balance Sheets as a component of accumulated other comprehensive loss. The overall effect of the translation of foreign currency and foreign currency transactions to date has been insignificant.

Income Taxes

Income taxes are accounted for under the asset and liability method. Deferred tax assets and liabilities are recognized for the future tax consequences attributable to differences between the financial statement carrying amounts of existing assets and liabilities and their respective tax bases and operating loss and tax credit carryforwards. Deferred tax assets and liabilities are measured using enacted tax rates expected to apply to taxable income in the years in which those temporary differences are expected to be recovered or settled. The effect on deferred tax assets and liabilities of a change in tax rates is recognized in income in the period that includes the enactment date. The Company recognizes the effect of income tax positions only if those positions are more likely than not of being sustained. Recognized income tax positions are measured at the largest amount of which the likelihood of realization is greater than 50%. Changes in recognition or measurement are reflected in the period in which the change in judgment occurs. The Company records interest and penalties, if any, related to unrecognized tax benefits as a component of tax expense.

Share-Based Payment Awards

The Company recognizes in the Consolidated Statements of Income the grant-date fair value of equity-based awards such as shares issued under employee stock purchase plans, restricted stock awards, restricted stock units and performance unit awards issued to employees and directors.

The grant-date fair value of stock awards is based on the closing price of the stock on the date of grant. The fair value of share-based awards is recognized as compensation expense on a straight-line basis over the requisite service period, net of forfeitures. The Company issues new shares upon the respective grant, exercise or vesting of the share-based payment awards, as applicable.

Performance unit awards are subject to either a performance-based or market-based vesting requirement. For performance-based vesting, the grant-date fair value of the award, based on fair value of the Company's common stock, is recognized over the service period, based on an assessment of the likelihood that the applicable performance goals will be achieved and compensation expense is periodically adjusted based on actual and expected performance. Compensation expense for performance unit awards with market-based vesting is calculated based on the estimated fair value as of the grant date utilizing a Monte Carlo simulation model and is recognized over the service period on a straight-line basis.

Recent Accounting Pronouncements

In January 2017, the FASB issued ASU No. 2017-04, *Intangibles – Goodwill and Other (Topic 350): Simplifying the Test of Goodwill Impairment*, eliminating the requirement to calculate the implied fair value, essentially eliminating step two from the goodwill impairment test. The new standard requires goodwill impairment to be based upon the results of step one of the impairment test, which is defined as the excess of the carrying value of a reporting unit over its fair value. The impairment charge will be limited to the amount of goodwill allocated to that reporting unit. The standards update is effective prospectively for annual and interim goodwill impairment testing performed in fiscal years beginning after December 15, 2019. The adoption of ASU 2017-04, beginning on January 1, 2020, did not have a significant impact on the Consolidated Financial Statements and related disclosures.

In June 2016, the FASB issued ASU No. 2016-13, *Financial Instruments: Credit Losses (Topic 326)*, which requires measurement and recognition of expected losses for financial assets held. The new standard changes the impairment model for most financial instruments, including trade receivables, from an incurred loss method to a new-forward looking approach, based on expected losses. The estimate of expected credit losses will require organizations to incorporate considerations of historical information, current conditions and reasonable and supportable forecasts. The standards update is effective prospectively for annual and interim periods in fiscal years beginning after December 15, 2019. The adoption of ASU 2016-13, beginning on January 1, 2020, did not have a significant impact on the Consolidated Financial Statements and related disclosures.

3. CASH, CASH EQUIVALENTS AND INVESTMENTS:

The Company's portfolio of fixed income securities consists of term bank certificates of deposit and U.S. Government bonds. The Company considers all highly liquid debt instruments purchased with an original maturity (maturity at the purchase date) of three months or less to be cash equivalents. The Company classifies its remaining debt security investments as available-for-sale. These debt securities are carried at fair market value, with unrealized gains and losses reported in shareholders' equity. Gains or losses on securities sold are based on the specific identification method.

Cash and Cash Equivalents

The following table provides details regarding the Company's portfolio of cash and cash equivalents (in thousands):

Cash and Cash Equivalents Classification	Amortized Cost	Unrealized Gains	Unrealized (Losses)	Aggregate Fair Market Value
December 31, 2020				
Cash accounts in banking institutions	$ 163,779	$ —	$ —	$ 163,779
Money market accounts	17,261	—	—	17,261
U.S. Government bonds	448,970	6	(4)	448,972
	$ 630,010	$ 6	$ (4)	$ 630,012
December 31, 2019				
Cash accounts in banking institutions	$ 119,272	$ —	$ —	$ 119,272
Money market accounts	12,355	—	—	12,355
	$ 131,627	$ —	$ —	$ 131,627

Short-term Investments

The following table provides details regarding the Company's portfolio of short-term investments (in thousands):

Short-term Investments Classification	Amortized Cost	Unrealized Gains	Unrealized (Losses)	Aggregate Fair Market Value
December 31, 2020				
U.S. Government bonds	$ 99,929	$ 67	$ —	$ 99,996
	$ 99,929	$ 67	$ —	$ 99,996
December 31, 2019				
Certificates of deposit	$ 700	$ —	$ —	$ 700
U.S. Government bonds	513,577	190	(6)	513,761
	$ 514,277	$ 190	$ (6)	$ 514,461

Minority Investments

The Company's portfolio of minority investments consists of investments in privately held early stage companies primarily motivated to gain early access to new technology and are passive in nature in that the Company does not obtain representation on the board of directors of the companies in which it invests. As of December 31, 2020, the Company had one minority investment with a carrying value of $5.0 million accounted for as an equity security without a readily determinable fair value.

4. FAIR VALUE MEASUREMENTS:

The following table provides the assets and liabilities carried at fair value measured on a recurring basis as of December 31, 2020 (in thousands):

		Fair Value Measurements, Using		
	Total Carrying Value as of December 31, 2020	Quoted Prices in Active Markets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Cash equivalents	$ 466,233	$ 466,233	$ —	$ —
Short-term investments	99,996	99,996	—	—

The following table provides the assets and liabilities carried at fair value measured on a recurring basis as of December 31, 2019 (in thousands):

		Fair Value Measurements, Using		
	Total Carrying Value as of December 31, 2019	Quoted Prices in Active Markets (Level 1)	Significant Other Observable Inputs (Level 2)	Significant Unobservable Inputs (Level 3)
Cash equivalents	$ 12,355	$ 12,355	$ —	$ —
Short-term investments	514,461	514,461	—	—

Level 1 inputs are quoted prices (unadjusted) in active markets for identical assets or liabilities. Level 2 inputs are quoted prices for similar assets and liabilities in active markets or inputs that are observable for the asset or liability, either directly or indirectly through market corroboration, for substantially the full term of the financial instrument. Level 3 inputs are unobservable inputs based on management's own assumptions used to measure assets and liabilities at fair value. A financial asset's or liability's classification is determined based on the lowest level input that is significant to the fair value measurement.

Changes in fair value of the debt investments are recorded as unrealized gains and losses in accumulated other comprehensive loss on the Consolidated Balance Sheets and any credit losses on debt investments are recorded as an allowance for credit losses with an offset recognized in other income, net on the Consolidated Statements of Income. There were no credit losses on debt investments as of December 31, 2020 or December 31, 2019.

5. INVENTORY:

Inventory consisted of the following (in thousands):

	December 31,	
	2020	2019
Raw materials	$ 46,843	$ 25,920
Work-in-process	9,904	7,987
Finished goods	34,844	30,046
Inventory	$ 91,591	$ 63,953

The Company recorded an increase in inventory reserve of $1.1 million, $5.9 million and $3.6 million for the years ended December 31, 2020, 2019 and 2018, respectively, due to excess inventory levels in certain products.

6. PROPERTY AND EQUIPMENT:

Property and equipment consist of the following (in thousands):

	December 31,	
	2020	2019
Land	$ 2,642	$ 2,642
Building and improvements	53,568	47,994
Office and lab equipment	85,881	74,726
Furniture, fixtures and computer related assets	8,921	7,592
Construction-in-progress	23,594	12,194
	174,606	145,148
Less: Accumulated depreciation	(72,493)	(57,276)
Property and equipment, net	$ 102,113	$ 87,872

Depreciation expense was $15.2 million, $12.5 million and $8.6 million for the years ended December 31, 2020, 2019 and 2018, respectively.

7. GOODWILL AND INTANGIBLE ASSETS:

The Company monitors the recoverability of goodwill annually or whenever events or changes in circumstances indicate the carrying value may not be recoverable. Purchased intangible assets subject to amortization consist primarily of acquired technology and other intangible assets that include trade names, customer relationships and developed intellectual property (IP) processes.

Acquired Technology

Acquired technology consists of acquired license rights for patents and know-how obtained from PD-LD, Inc., Motorola, BASF SE (BASF) and Fujifilm. These intangible assets consist of the following (in thousands):

	December 31,	
	2020	2019
PD-LD, Inc.	$ 1,481	$ 1,481
Motorola	15,909	15,909
BASF	95,989	95,989
Fujifilm	109,462	109,462
Other	462	401
	223,303	223,242
Less: Accumulated amortization	(153,050)	(132,468)
Acquired technology, net	$ 70,253	$ 90,774

Amortization expense related to acquired technology was $20.6 million for each of the years ended December 31, 2020, 2019 and 2018. Amortization expense is included in amortization of acquired technology and other intangible assets expense line item on the Consolidated Statements of Income and is expected to be $20.6 million in the year ending December 31, 2021, $15.8 million in the year ending December 31, 2022, $9.7 million in the year ending December 31, 2023, $9.6 million in the years ending December 31, 2024 and 2025 and $4.9 million in total thereafter.

Fujifilm Patent Acquisition

On July 23, 2012, the Company entered into a Patent Sale Agreement with Fujifilm. Under the agreement, Fujifilm sold more than 1,200 OLED-related patents and patent applications in exchange for a cash payment of $105.0 million, plus costs incurred in connection with the purchase. The agreement contains customary representations and warranties and covenants, including respective covenants not to sue by both parties thereto. The agreement permitted the Company to assign all of its rights and obligations under the agreement to its affiliates, and the Company assigned, prior to the consummation of the transactions contemplated by the agreement, its rights and obligations to UDC Ireland, a wholly-owned subsidiary of the Company formed under the laws of the Republic of Ireland. The transactions contemplated by the agreement were consummated on July 26, 2012. The Company recorded the $105.0 million plus $4.5 million of purchase costs as acquired technology, which is being amortized over a period of 10 years.

BASF Patent Acquisition

On June 28, 2016, UDC Ireland entered into and consummated an IP Transfer Agreement with BASF. Under the IP Transfer Agreement, BASF sold to UDC Ireland all of its rights, title and interest to certain of its owned and co-owned intellectual property rights relating to the composition of, development, manufacture and use of OLED materials, including OLED lighting and display stack technology, as well as certain tangible assets. The intellectual property includes knowhow and more than 500 issued and pending patents in the area of phosphorescent materials and technologies. These assets were acquired in exchange for a cash payment of €86.8 million ($95.8 million). In addition, UDC Ireland also took on certain rights and obligations under three joint research and development agreements to which BASF was a party. The IP Transfer Agreement also contains customary representations, warranties and covenants of the parties. UDC Ireland recorded the payment of €86.8 million ($95.8 million) and acquisition costs incurred of $217,000 as acquired technology, which is being amortized over a period of 10 years.

Other Intangible Assets

As a result of the Adesis acquisition in June 2016, the Company recorded $16.8 million of other intangible assets, including $10.5 million assigned to customer relationships with a weighted average life of 11.5 years, $4.8 million of internally developed IP, processes and recipes with a weighted average life of 15 years, and $1.5 million assigned to trade name and trademarks with a weighted average life of 10 years.

At December 31, 2020, these other intangible assets consist of the following (in thousands):

	December 31, 2020		
	Gross Carrying Amount	Accumulated Amortization	Net Carrying Amount
Customer relationships	$ 10,520	$ (4,059)	$ 6,461
Developed IP, processes and recipes	4,820	(1,428)	3,392
Trade name/Trademarks	1,500	(668)	832
Total identifiable other intangible assets	$ 16,840	$ (6,155)	$ 10,685

Amortization expense related to other intangible assets was $1.4 million for each of the years ended December 31, 2020, 2019, and 2018. Amortization expense is included in amortization of acquired technology and other intangible assets expense line item on the Consolidated Statements of Income and is expected to be $1.4 million for each of the next five fiscal years (2021 - 2025) and $3.7 million in total thereafter.

Goodwill

As a result of the Adesis acquisition, the Company recorded $15.5 million of goodwill. The Company performs its annual assessment of goodwill during the fourth quarter of the fiscal year unless events suggest an impairment may have been incurred in an interim period using Adesis' standalone financial operating performance information. Application of the goodwill impairment test requires the exercise of judgment, including the determination of the fair value of each reporting unit, as Adesis is considered to be the reporting unit. The Company estimates the fair value of reporting units using an income approach based on the present value of estimated future cash flows. As part of the annual assessment of goodwill completed during the fourth quarter ended December 31, 2020, there were no significant indicators to conclude that an impairment of the goodwill associated with the acquisition of Adesis had occurred.

8. LEASES:

The Company has entered into operating leases to facilitate the expansion of its manufacturing, research and development, and selling, general and administrative activities. For purposes of calculating operating lease liabilities, lease terms may be deemed to include options to extend or terminate the lease when those events are reasonably certain to occur. The interest rate implicit in lease contracts is typically not readily determinable and as such the Company uses the appropriate incremental borrowing rate based on information available at the lease commencement date in determining the present value of the lease payments. Current lease agreements do not contain any residual value guarantees or material restrictive covenants. As of December 31, 2020, the Company did not have any finance leases and no additional operating leases that have not yet commenced.

The Company adopted Topic 842 on January 1, 2019 using the modified retrospective transition method. As such, the Company did not restate financial statement or lease disclosure data for periods prior to January 1, 2019, which was prepared in accordance with ASC Topic 840, *Leases*.

The following table presents the Company's operating lease cost and supplemental cash flow information related to the Company's operating leases (in thousands):

	Year Ended December 31,	
	2020	2019
Operating lease cost	$ 2,091	$ 1,855
Non-cash activity:		
Right-of-use assets obtained in exchange for lease obligations	$ 1,948	$ 9,776

Operating lease cost was $1.7 million for the year ended December 31, 2018

The following table presents the Company's operating lease right-of-use assets and liabilities (in thousands):

	December 31,	
	2020	2019
Right-of-use assets	$ 8,750	$ 8,482
Short-term lease liabilities	1,871	1,606
Long-term lease liabilities	6,879	6,876

The following table presents weighted average assumptions used to compute the Company's right-of-use assets and lease liabilities:

	December 31, 2020
Weighted average remaining lease term (in years)	6.0
Weighted average discount rate	4.6%

As of December 31, 2020, current operating leases had remaining terms between two and eight years with options to extend the lease terms.

Undiscounted future minimum lease payments as of December 31, 2020, by year and in the aggregate, having non-cancelable lease terms in excess of one year were as follows (in thousands):

	Maturities of Operating Lease Liabilities
2021	$ 2,174
2022	2,093
2023	1,195
2024	1,007
2025	787
Thereafter	2,967
Total lease payments	10,223
Less: imputed interest	(1,473)
Present value of lease payments	$ 8,750

9. ACCRUED EXPENSES:

Accrued expenses consist of the following (in thousands):

	December 31,	
	2020	2019
Compensation	$ 22,147	$ 30,295
Royalties	11,125	11,776
Research and development agreements	5,029	3,052
Consulting	771	471
Professional Fees	908	268
Other	1,424	3,160
Accrued Expenses	$ 41,404	$ 49,022

10. RESEARCH AND LICENSE AGREEMENTS WITH PRINCETON UNIVERSITY, UNIVERSITY OF SOUTHERN CALIFORNIA AND THE UNIVERSITY OF MICHIGAN:

The Company has long-standing relationships with Princeton University (Princeton) and the University of Southern California (USC), dating back to 1994, for the conduct of research relating to the Company's OLED and other organic thin-film technologies and materials. This research had been performed at Princeton under the direction of Professor Stephen R. Forrest and at USC under the direction of Professor Mark E. Thompson.

Under an Amended License Agreement entered into in 1997 by the Company, Princeton and USC (as amended, the 1997 Amended License Agreement), Princeton and USC granted the Company worldwide, exclusive license rights, with rights to sublicense, to make, have made, use, lease and/or sell products and to practice processes based on patent applications and issued

patents arising out of research performed by Princeton and USC for the Company. Under the 1997 Amended License Agreement, the Company pays Princeton royalties of 3% of the net sales price for licensed products it sells or 3% of the revenues the Company receives from its sublicensees for their sale of licensed products. The Company recorded royalty expense in connection with this agreement of $11.1 million, $11.8 million and $7.0 million for the years ended December 31, 2020, 2019 and 2018, respectively.

In 2006, Professor Forrest transferred from Princeton to the University of Michigan (Michigan) and the Company amended the 1997 Amended License Agreement to include Michigan as a party to that agreement. Also in connection with the transfer, the Company entered into a sponsored research agreement with USC under which the Company continues to fund organic electronics research being conducted by Professors Forrest and Thompson (the 2006 Research Agreement). Work by Professor Forrest is being funded through a subcontract between USC and Michigan. The 2006 Research Agreement extends through April 2023 with an option to further extend for an additional two years.

The Company makes payments under the 2006 Research Agreement to USC on a quarterly basis as actual expenses are incurred. As of December 31, 2020, the Company was obligated to pay USC up to $6.9 million for work to be performed during the remaining extended term. The Company recorded research and development expense in connection with work performed under the 2006 Research Agreement of $1.2 million, $997,000 and $1.1 million for the years ended December 31, 2020, 2019 and 2018, respectively.

11. EQUITY AND CASH COMPENSATION UNDER THE PPG AGREEMENTS:

On September 22, 2011, the Company entered into an Amended and Restated OLED Materials Supply and Service Agreement with PPG (the New OLED Materials Agreement), which replaced the original OLED Materials Agreement with PPG effective as of October 1, 2011. The term of the New OLED Materials Agreement ran through December 31, 2015 and shall be automatically renewed for additional one-year terms, unless terminated by the Company by providing prior notice of one year or terminated by PPG by providing prior notice of two years. The agreement was automatically renewed through December 31, 2021. The New OLED Materials Agreement contains provisions that are substantially similar to those of the original OLED Materials Agreement. Under the New OLED Materials Agreement, PPG continues to assist the Company in developing its proprietary OLED materials and supplying the Company with those materials for evaluation purposes and for resale to its customers.

Under the New OLED Materials Agreement, the Company compensates PPG on a cost-plus basis for the services provided during each calendar quarter. The Company is required to pay for some of these services in all cash. Up to 50% of the remaining services are payable, at the Company's sole discretion, in cash or shares of the Company's common stock, with the balance payable in cash. The actual number of shares of common stock issuable to PPG is determined based on the average closing price for the Company's common stock during a specified number of days prior to the end of each calendar half-year period ending on March 31 and September 30. If, however, this average closing price is less than $20.00, the Company is required to compensate PPG in cash. No shares were issued for services to PPG for the years ended December 31, 2020, 2019 and 2018.

The Company is also required to reimburse PPG for raw materials used for research and development. The Company records the purchases of these raw materials as a current asset until such materials are used for research and development efforts.

The Company recorded research and development expense of $2.8 million, $1.4 million and $771,000 for the years ended December 31, 2020, 2019 and 2018, respectively, in relation to the cash portion of the reimbursement of expenses and work performed by PPG, excluding amounts paid for commercial chemicals.

12. SHAREHOLDERS' EQUITY:

Preferred Stock

The Company's Amended and Restated Articles of Incorporation authorize it to issue up to 5,000,000 shares of $0.01 par value preferred stock with designations, rights and preferences determined from time-to-time by the Company's Board of Directors. Accordingly, the Company's Board of Directors is empowered, without shareholder approval, to issue preferred stock with dividend, liquidation, conversion, voting or other rights superior to those of shareholders of the Company's common stock.

In 1995, the Company issued 200,000 shares of Series A Nonconvertible Preferred Stock (Series A) to American Biomimetics Corporation (ABC) pursuant to a certain Technology Transfer Agreement between the Company and ABC. The Series A shares have a liquidation value of $7.50 per share. Series A shareholders, as a single class, have the right to elect two members of the Company's Board of Directors. This right has never been exercised. Holders of the Series A shares are entitled to one vote per share on matters which shareholders are generally entitled to vote. The Series A shareholders are not entitled to any dividends.

As of December 31, 2020, the Company had issued 200,000 shares of preferred stock, all of which were outstanding.

Common Stock

The Company's Amended and Restated Articles of Incorporation authorize it to issue up 200,000,000 shares of $0.01 par value common stock. Each share of the Company's common stock entitles the holder to one vote on all matters to be voted upon by the shareholders.

As of December 31, 2020, the Company had issued 49,013,476 shares of common stock, of which 47,647,828 were outstanding. During the year ended December 31, 2020, the Company repurchased no shares of common stock. During the year ended December 31, 2019, the Company repurchased 4,011 shares of common stock, now held as treasury stock, for an aggregate purchase price of $649,000.

Scientific Advisory Board Awards

During the years ended December 31, 2020 and 2019, the Company granted a total of 1,926 and 1,960 shares, respectively, of fully vested common stock to non-employee members of the Scientific Advisory Board for services performed in 2019 and 2018, respectively. The fair value of the shares issued to members of the Scientific Advisory Board was $300,000 for both years ended December 31, 2020 and 2019.

Dividends

During the year ended December 31, 2020, the Company declared and paid cash dividends of $0.60 per common share, or $28.4 million, on the Company's outstanding common stock.

On February 16, 2021, the Company's Board of Directors declared a first quarter dividend of $0.20 per common share to be paid on March 31, 2021 to all shareholders of record as of the close of business on March 16, 2021. All future dividends will be subject to the approval of the Company's Board of Directors.

13. ACCUMULATED OTHER COMPREHENSIVE LOSS:

Amounts related to the changes in accumulated other comprehensive loss were as follows (in thousands):

	Unrealized Gain (Loss) on Available-for-Sale-Securities	Net Unrealized Gain (Loss) on Retirement Plan [2]	Change in Cumulative Foreign Currency Translation Adjustment	Total	Affected Line items in the Consolidated Statements of Income
Balance January 1, 2018, net of tax	$ (258)	$ (11,169)	$ (37)	$ (11,464)	
Other comprehensive gain (loss) before reclassification	268	(6,690)	(9)	(6,431)	
Reclassification to net income (1)	—	1,661	—	1,661	Selling, general and administrative, research and development and cost of sales
Change during period	268	(5,029)	(9)	(4,770)	
Balance December 31, 2018, net of tax	10	(16,198)	(46)	(16,234)	
Other comprehensive gain (loss) before reclassification	181	(3,492)	—	(3,311)	
Reclassification to net income (1)	—	2,523	25	2,548	Selling, general and administrative, research and development and cost of sales
Change during period	181	(969)	25	(763)	
Balance December 31, 2019, net of tax	191	(17,167)	(21)	(16,997)	
Other comprehensive loss before reclassification	(100)	(21,464)	(14)	(21,578)	
Reclassification to net income (1)	—	2,556	—	2,556	Selling, general and administrative, research and development and cost of sales
Change during period	(100)	(18,908)	(14)	(19,022)	
Balance December 31, 2020, net of tax	$ 91	$ (36,075)	$ (35)	$ (36,019)	

(1) The Company reclassified amortization of prior service cost, actuarial loss and plan amendment cost for its retirement plan from accumulated other comprehensive loss to net income of $2.6 million, $2.5 million and $1.7 million for the years ended December 31, 2020, 2019 and 2018, respectively.

(2) Refer to Note 15: Employee Retirement Plans

14. STOCK-BASED COMPENSATION:

Equity Compensation Plan

The Equity Compensation Plan provides for the granting of incentive and nonqualified stock options, shares of common stock, stock appreciation rights and performance units to employees, directors and consultants of the Company. Stock options are exercisable over periods determined by the Compensation Committee, but for no longer than 10 years from the grant date. Through December 31, 2020, the Company's shareholders have approved increases in the number of shares reserved for issuance under the Equity Compensation Plan to 10,500,000, and have extended the term of the plan through 2024. As of December 31, 2020, there were 2,001,339 shares that remained available to be granted under the Equity Compensation Plan.

Restricted Stock Award and Units

The Company has issued restricted stock awards and units to employees and non-employees with vesting terms of one to six years. The fair value is equal to the market price of the Company's common stock on the date of grant for awards granted to employees and equal to the market price at the end of the reporting period for unvested non-employee awards or upon the date of vesting for vested non-employee awards. Expense for restricted stock awards and units is amortized ratably over the vesting period for the awards issued to employees and using a graded vesting method for the awards issued to non-employees.

The following table summarizes the activity related to restricted stock unit (RSU) share based payment awards:

	Number of Shares	Weighted-Average Grant-Date Fair Value
Unvested, January 1, 2020	98,810	$ 144.53
Granted	143,179	162.32
Vested	(47,750)	136.59
Forfeited	(1,615)	122.83
Unvested, December 31, 2020	192,624	$ 160.99

The weighted average grant-date fair value of RSU awards granted was $162.32, $168.95 and $115.48 during the years ended December 31, 2020, 2019 and 2018, respectively. The fair value as of the respective vesting dates of RSUs was $7.7 million, $7.7 million and $8.1 million for 2020, 2019 and 2018, respectively.

The following table summarizes the activity related to restricted stock award (RSA) share based payment awards:

	Number of Shares	Weighted-Average Grant-Date Fair Value
Unvested, January 1, 2020	311,643	$ 80.94
Granted	1,926	155.85
Vested	(171,908)	50.65
Unvested, December 31, 2020	141,661	$ 124.81

The weighted average grant-date fair value of RSA awards granted was $155.85, $194.19 and $122.15 during the years ended December 31, 2020, 2019 and 2018, respectively. The fair value as of the respective vesting dates of RSAs was $24.5 million, $28.4 million and $17.7 million for 2020, 2019 and 2018, respectively.

For the years ended December 31, 2020, 2019 and 2018, the Company recorded, as compensation charges related to restricted stock awards and units issued to employees and non-employees, selling, general and administrative expense of $13.9 million, $10.0 million and $7.6 million, respectively, cost of sales of $1.9 million, $1.1 million and $758,000, respectively, and research and development expense of $4.3 million, $2.5 million and $2.0 million, respectively.

In connection with the vesting of restricted stock awards and units during the years ended December 31, 2020, 2019 and 2018, 86,442, 86,075 and 86,679 shares, respectively, with aggregate fair values of $12.5 million, $14.0 million and $9.2 million, respectively, were withheld in satisfaction of tax withholding obligations and are reflected as a financing activity within the Consolidated Statements of Cash Flows.

For the years ended December 31, 2020, 2019 and 2018, the Company recorded as compensation charges related to all restricted stock units to non-employee members of the Scientific Advisory Board, whose unvested shares are marked to market each reporting period, research and development expense of $380,000, $632,000 and $64,000, respectively.

The Company has granted restricted stock units to non-employee members of the Board of Directors with quarterly vesting over a period of approximately one year. The fair value is equal to the market price of the Company’s common stock on the date of grant. The restricted stock units are issued and expense is recognized ratably over the vesting period. For the years ended December 31, 2020, 2019 and 2018, the Company recorded compensation charges for services performed, related to all restricted stock units granted to non-employee members of the Board of Directors, selling, general and administrative expense of $1.3 million, $916,000 and $4.3 million, respectively. In connection with the vesting of the restricted stock, the Company issued to non-employee members of the Board of Directors 6,456, 9,332 and 25,000 shares during the years ended December 31, 2020, 2019 and 2018, respectively.

As of December 31, 2020, the total unrecognized expense related to all restricted stock awards and units was $31.7 million, which the Company expects to recognize over a weighted average period of 1.89 years.

Performance Unit Awards

Each performance unit award is subject to both a performance-vesting requirement (either performance-based or market-based) and a service-vesting requirement. The performance-based vesting requirement is tied to the Company's cumulative revenue growth compared to the cumulative revenue growth of companies comprising the Nasdaq Electronics Components Index, as measured over a

specific performance period. The market-based vesting requirement is tied to the Company's total shareholder return relative to the total shareholder return of companies comprising the Nasdaq Electronics Components Index, as measured over a specific performance period. The maximum number of performance units that may vest based on performance is two times the shares granted. Further, if the Company's total shareholder return is negative, the performance units will not vest at all.

The following table summarizes the activity related to performance unit awards (PSU) share based payment awards:

	Number of Shares	Weighted-Average Grant-Date Fair Value
Unvested, January 1, 2020	37,781	$ 134.97
Granted	111,410	167.74
Vested	(31,276)	105.65
Unvested, December 31, 2020	117,915	$ 165.48

During the years ended December 31, 2020, 2019 and 2018, the Company granted 95,772, 10,096 and 40,601 performance units, respectively, of which 47,885, 5,050 and 6,022 units, respectively, are subject to performance-based vesting requirements and 47,887, 5,046 and 6,025 units, respectively, are subject to market-based vesting requirements, and will vest over the terms as described above. During the years ended December 31, 2020, 2019 and 2018, there were also 15,638, 15,650 and 28,554 incremental performance-based shares, respectively, that vested resulting from an increased vesting factor based on Company performance. The weighted average grant date fair value of the performance unit awards granted was $167.74, $198.72 and $119.62 during the years ended December 31, 2020, 2019 and 2018, respectively, as determined by the Company’s common stock on date of grant for the units with performance-based vesting and a Monte-Carlo simulation for the units with market-based vesting.

For the years ended December 31, 2020, 2019 and 2018, the Company recorded, as compensation charges related to all performance stock units, selling, general and administrative expense of $4.3 million, $1.7 million and $1.3 million, respectively, cost of sales of $670,000, $208,000 and $141,000, respectively, and research and development expense of $1.1 million, $419,000 and $330,000, respectively.

In connection with the vesting of performance units during the years ended December 31, 2020, 2019 and 2018, 12,877, 16,668 and 25,208 shares, respectively, with aggregate fair values of $1.9 million, $2.6 million and $2.9 million, respectively, were withheld in satisfaction of tax withholding obligations and are reflected as a financing activity within the Consolidated Statements of Cash Flows.

As of December 31, 2020, the total unrecognized compensation expense related to performance unit awards was $12.9 million, which the Company expects to recognize over a weighted average period of 2.12 years.

Employee Stock Purchase Plan

On April 7, 2009, the Board of Directors of the Company adopted an Employee Stock Purchase Plan (ESPP). The ESPP was approved by the Company’s shareholders and became effective on June 25, 2009. The Company has reserved 1,000,000 shares of common stock for issuance under the ESPP. Unless terminated by the Board of Directors, the ESPP will expire when all reserved shares have been issued.

Eligible employees may elect to contribute to the ESPP through payroll deductions during consecutive three-month purchase periods, the first of which began on July 1, 2009. Each employee who elects to participate will be deemed to have been granted an option to purchase shares of the Company’s common stock on the first day of the purchase period. Unless the employee opts out during the purchase period, the option will automatically be exercised on the last day of the period, which is the purchase date, based on the employee’s accumulated contributions to the ESPP. The purchase price will equal 85% of the lesser of the closing price per share of common stock on the first day of the period or the last business day of the period.

Employees may allocate up to 10% of their base compensation to purchase shares of common stock under the ESPP; however, each employee may purchase no more than 12,500 shares on a given purchase date, and no employee may purchase more than $25,000 of common stock under the ESPP during a given calendar year.

For the years ended December 31, 2020, 2019 and 2018, the Company issued 9,668, 7,492 and 10,303 shares, respectively, of its common stock under the ESPP, resulting in proceeds of $1.2 million, $889,000 and $798,000, respectively. For the years ended December 31, 2020, 2019 and 2018, the Company recorded charges of $96,000, $79,000 and $82,000, respectively, to selling, general and administrative expense, $111,000, $73,000, $81,000, respectively, to cost of sales and $139,000, $118,000 and $130,000,

respectively, to research and development expense, related to the ESPP equal to the amount of the discount and the value of the look-back feature.

15. EMPLOYEE RETIREMENT PLANS:

Defined Contribution Plan

The Company maintains the Universal Display Corporation 401(k) Plan (the Plan) in accordance with the provisions of Section 401(k) of the Internal Revenue Code (the Code). The Plan covers substantially all full-time employees of the Company. Participants may contribute up to 90% of their total compensation to the Plan, not to exceed the limit as defined in the Code. Once an employee is eligible to participate in the Plan, the Company will make a non-elective contribution equal to 3% of the employee's total compensation. For the years ended December 31, 2020, 2019 and 2018, the Company contributed $1.1 million, $880,000 and $1.2 million, respectively, to the Plan.

Defined Benefit Plan

On March 18, 2010, the Compensation Committee and the Board of Directors of the Company approved and adopted the Universal Display Corporation Supplemental Executive Retirement Plan (SERP), effective as of April 1, 2010. On March 3, 2015, the Compensation Committee and the Board of Directors amended the SERP to include salary and bonus as part of the plan. Prior to this amendment, the SERP benefit did not take into account any bonuses. The purpose of the SERP, which is unfunded, is to provide certain of the Company's key employees with supplemental pension benefits following a cessation of their employment. As of December 31, 2020 there were seven participants in the SERP.

The SERP benefit is based on a percentage of the participant's annual base salary and in certain cases, the participant's average annual bonus for the most recent three fiscal years ending prior to the participant's date of termination of employment with the Company for the life of the participant. For this purpose, annual base salary means 12 times the average monthly base salary paid or payable to the participant during the 24-month period immediately preceding the participant's date of termination of employment, or, if required, the date of a change in control of the Company.

Under the SERP, if a participant resigns or is terminated without cause at or after age 65 and with at least 20 years of service, he or she will be eligible to receive a SERP benefit. The benefit is based on a percentage of the participant's annual base salary and bonus for the life of the participant. This percentage is 50%, 25% or 15%, depending on the participant's benefit class.

If a participant resigns at or after age 65 and with at least 15 years of service, he or she will be eligible to receive a prorated SERP benefit. If a participant is terminated without cause or on account of a disability after at least 15 years of service, he or she will be eligible to receive a prorated SERP benefit regardless of age. The prorated benefit in either case would be based on the participant's number of years of service (up to 20), divided by 20. In the event a participant is terminated for cause, his or her SERP benefit and any future benefit payments are subject to immediate forfeiture.

The SERP benefit is payable in installments over 10 years, beginning at the later of age 65 or the date of the participant's separation from service. Payments are based on a present value calculation of the benefit amount for the actuarial remaining life expectancy of the participant. This calculation is made as of the date benefit payments are to begin (later of age 65 or separation from service). If the participant dies after reaching age 65, any future or remaining benefit payments are made to the participant's beneficiary or estate. If the participant dies before reaching age 65, the benefit is forfeited.

In the event of a change in control of the Company, each participant will become immediately vested in his or her SERP benefit. Unless the participant's benefit has already fully vested, if the participant has less than 20 years of service at the time of the change in control, he or she will receive a prorated benefit based on his or her number of years of service (up to 20), divided by 20. If the change in control qualifies as a "change in control event" for purposes of Section 409A of the Internal Revenue Code, then each participant (including former employees who are entitled to SERP benefits) will receive a lump sum cash payment equal to the present value of the benefit immediately upon the change in control.

Certain of the Company's executive officers are designated as special participants under the SERP. If these participants resign or are terminated without cause after 20 years of service, or at or after age 65 and with at least 15 years of service, they will be eligible to receive a SERP benefit. If they are terminated without cause or on account of a disability, they will be eligible to receive a prorated SERP benefit regardless of age. The prorated benefit would be based on the participant's number of years of service (up to 20), divided by 20.

The SERP benefit for special participants is based on 50% of their annual base salary and bonus for their life and the life of their surviving spouse, if any. Payments are based on a present value calculation of the benefit amount for the actuarial remaining life

expectancies of the participant and their surviving spouse, if any. If they die before reaching age 65, the benefit is not forfeited if the surviving spouse, if any, lives until the participant would have reached age 65. If their spouse also dies before the participant would have reached age 65, the benefit is forfeited.

The Company records amounts relating to the SERP based on calculations that incorporate various actuarial and other assumptions, including discount rates, rate of compensation increases, retirement dates, and life expectancies. The net periodic costs are recognized as employees render the services necessary to earn the SERP benefits.

In connection with the initiation and subsequent amendments of the SERP, the Company recorded cost related to prior service of $43.4 million as accumulated other comprehensive loss as of December 31, 2020. The prior service cost is being amortized as a component of net periodic pension cost over the average of the remaining service period of the employees expected to receive benefits under the plan. The prior service cost expected to be amortized for the year ending December 31, 2021 is $6.0 million.

Information relating to the Company's plan is as follows (in thousands):

	Year Ended December 31,	
	2020	2019
Change in benefit obligation:		
Benefit obligation, beginning of year	$ 51,117	$ 44,055
Service cost	1,092	969
Interest cost	1,285	1,613
Actuarial loss	25,033	4,480
Benefit obligation, end of year	78,527	51,117
Fair value of plan assets	—	—
Unfunded status of the plan, end of year	$ 78,527	$ 51,117
Current liability	—	—
Noncurrent liability	$ 78,527	$ 51,117

The accumulated benefit obligation for the plan was $74.2 million and $48.1 million as of December 31, 2020 and 2019, respectively. The large increase in actuarial loss was due to higher bonus cash payments in March 2020 with the associated bonus expense accrual recorded in the fiscal year ended December 31, 2019.

The components of net periodic pension cost were as follows (in thousands):

	Year Ended December 31,		
	2020	2019	2018
Service cost	$ 1,092	$ 969	$ 1,301
Interest cost	1,285	1,613	1,047
Amortization of prior service cost	1,098	1,595	1,683
Amortization of loss	2,181	1,641	435
Total net periodic benefit cost	$ 5,656	$ 5,818	$ 4,466

The measurement date is the Company's fiscal year end. The net periodic pension cost is based on assumptions determined at the prior year end measurement date.

Assumptions used to determine the year end benefit obligation were as follows:

	Year Ended December 31,	
	2020	2019
Discount rate	1.54%	2.64%
Rate of compensation increases	3.50%	3.50%

Assumptions used to determine the net periodic pension cost were as follows:

	Year Ended December 31,		
	2020	2019	2018
Discount rate	2.64%	3.82%	3.22%
Rate of compensation increases	3.50%	3.50%	3.50%

Actuarial gains and losses are amortized from accumulated other comprehensive loss into net periodic pension cost over future years based upon the average remaining service period of active plan participants, when the accumulation of such gains or losses exceeds 10% of the year end benefit obligation. The cost or benefit of plan changes that increase or decrease benefits for prior employee service (prior service cost or credit) is included in the Company's results of income on a straight-line basis over the average remaining service period of active plan participants.

The estimated amounts to be amortized from accumulated other comprehensive loss into the net periodic pension cost in 2021 are as follows (in thousands):

Amortization of prior service cost	$	1,099
Amortization of loss		4,936
Total	$	6,035

Benefit payments, which reflect estimated future service, are currently expected to be paid as follows (in thousands):

Year	Projected Benefits
2021	$ —
2022	5,945
2023	6,421
2024	6,421
2025	6,421
2026-2030	42,300
Thereafter	26,300

16. COMMITMENTS AND CONTINGENCIES:

Commitments

Under the 2006 Research Agreement with USC, the Company is obligated to make certain payments to USC based on work performed by USC under that agreement, and by Michigan under its subcontractor agreement with USC. See Note 10 for further explanation.

Under the terms of the 1997 Amended License Agreement, the Company is required to make minimum royalty payments to Princeton. See Note 10 for further explanation.

The Company has agreements with six executive officers and two employees which provide for certain cash and other benefits upon termination of employment of the officer or employee in connection with a change in control of the Company. If the executive's employment is terminated in connection with the change in control, the executive is entitled to a lump-sum cash payment equal to two times the sum of the average annual base salary and bonus of the officer and immediate vesting of all stock options and other equity awards that may be outstanding at the date of the change in control, among other items.

In order to manage manufacturing lead times and help ensure adequate material supply, the Company entered into a New OLED Materials Agreement (see Note 11) that allows PPG to procure and produce inventory based upon criteria as defined by the Company. These purchase commitments consist of firm, noncancelable and unconditional commitments. In certain instances, this agreement allows the Company the option to reschedule and adjust the Company's requirements based on its business needs prior to firm orders being placed. As of December 31, 2020, 2019 and 2018, the Company had purchase commitments for inventory of $13.7 million, $22.0 million and $15.9 million, respectively.

Patent Related Challenges and Oppositions

Each major jurisdiction in the world that issues patents provides both third parties and applicants an opportunity to seek a further review of an issued patent. The process for requesting and considering such reviews is specific to the jurisdiction that issued the patent in question, and generally does not provide for claims of monetary damages or a review of specific claims of infringement. The conclusions made by the reviewing administrative bodies tend to be appealable and generally are limited in scope and applicability to the specific claims and jurisdiction in question.

The Company believes that opposition proceedings are frequently commenced in the ordinary course of business by third parties who may believe that one or more claims in a patent do not comply with the technical or legal requirements of the specific jurisdiction in which the patent was issued. The Company views these proceedings as reflective of its goal of obtaining the broadest legally

permissible patent coverage permitted in each jurisdiction. Once a proceeding is initiated, as a general matter, the issued patent continues to be presumed valid until the jurisdiction's applicable administrative body issues a final non-appealable decision. Depending on the jurisdiction, the outcome of these proceedings could include affirmation, denial or modification of some or all of the originally issued claims. The Company believes that as OLED technology becomes more established and its patent portfolio increases in size, so will the number of these proceedings.

Below is a summary of an active proceeding that has been commenced against an issued patent that is exclusively licensed to the Company. The Company does not believe that the confirmation, loss or modification of the Company's rights in any individual claim or set of claims that are the subject of the following legal proceeding would have a material impact on the Company's materials sales or licensing business or on the Company's Consolidated Financial Statements, including its Consolidated Statements of Income, as a whole. However, as noted within the description, the following proceeding involves an issued patent that relates to the Company's fundamental phosphorescent OLED technologies and the Company intends to vigorously defend against claims that, in the Company's opinion, seek to restrict or reduce the scope of the originally issued claim, which may require the expenditure of significant amounts of the Company's resources. In certain circumstances, when permitted, the Company may also utilize a proceeding to request modification of the claims to better distinguish the patented invention from any newly identified prior art and/or improve the claim scope of the patent relative to commercially important categories of the invention.

Opposition to European Patent No. 1390962

On November 16, 2011, Osram AG and BASF SE each filed a Notice of Opposition to European Patent No. 1390962 (the EP '962 patent), which relates to the Company's white phosphorescent OLED technology. The EP '962 patent, which was issued on February 16, 2011, is a European counterpart patent to U.S. patents 7,009,338 and 7,285,907. They are exclusively licensed to the Company by Princeton, and the Company is required to pay all legal costs and fees associated with this proceeding.

The European Patent Office (EPO) combined the oppositions into a single opposition proceeding, and a hearing on this matter was held in December 2015, wherein the EPO Opposition Division revoked the patent claims for alleged insufficiencies under European Patent Convention Article 83. The Company believes the EPO's decision is erroneous and appealed the decision. Subsequent to the filing of the appeal, BASF withdrew its opposition to the patent. On appeal, the Appeals Division withdrew the lower Opposition Division's rejections with respect to a portion of the original subject matter and remanded the matter to the lower Opposition Division for further consideration. The patent, as originally granted, is deemed valid during the pendency of the opposition process.

At this time, based on its current knowledge, the Company believes that the patent being challenged should be declared valid and that a significant portion of the Company's claims should be upheld. However, the Company cannot make any assurances of this result.

In addition to the above proceeding and now concluded proceedings which have been referenced in prior filings, from time to time, the Company may have other proceedings that are pending which relate to patents the Company acquired as part of the Fujifilm patent or BASF OLED patent acquisitions or which relate to technologies that are not currently widely used in the marketplace.

17. CONCENTRATION OF RISK:

Revenues and accounts receivable from the Company's largest customers for the years ended December 31, were as follows (in thousands):

	2020		2019		2018	
Customer	% of Total Revenue	Accounts Receivable	% of Total Revenue	Accounts Receivable	% of Total Revenue	Accounts Receivable
A	41%	$ 20,476	44%	$ 13,830	37%	$ 14,419
B	30%	26,776	27%	19,346	33%	11,990
C	13%	2,757	15%	10,592	10%	9,071

Revenues from outside of North America represented approximately 97%, 97%, and 94% of consolidated revenue for the years ended December 31, 2020, 2019 and 2018, respectively. Revenues by geographic area are as follows (in thousands):

Country	Year Ended December 31, 2020	2019	2018
South Korea	$ 263,079	$ 250,562	$ 171,915
China	142,076	135,259	51,931
Japan	7,405	5,276	6,823
Other non-U.S. locations	1,728	2,270	2,967
Total non-U.S. locations	414,288	393,367	233,636
United States	14,579	11,810	13,778
Total revenue	$ 428,867	$ 405,177	$ 247,414

The Company attributes revenue to different geographic areas on the basis of the location of the customer.

Long-lived assets (net), by geographic area are as follows (in thousands):

	2020	2019
United States	$ 93,230	$ 80,027
Other	8,883	7,845
Total long-lived assets	$ 102,113	$ 87,872

Substantially all chemical materials were purchased from one supplier. See Note 11.

18. INCOME TAXES:

The components of income before income taxes are as follows (in thousands):

	Year ended December 31, 2020	2019	2018
United States	$ 38,839	$ 53,629	$ 13,565
Foreign	124,690	116,276	50,746
Income before income taxes	$ 163,529	$ 169,905	$ 64,311

The components of the income tax expense are as follows (in thousands):

	Year ended December 31, 2020	2019	2018
Current income tax (expense) benefit:			
Federal	$ (14,773)	$ (20,108)	$ (9,097)
State	(568)	(755)	(511)
Foreign	(19,262)	(16,514)	(8,677)
	(34,603)	(37,377)	(18,285)
Deferred income tax (expense) benefit:			
Federal	4,883	5,208	12,622
State	(34)	1,054	611
Foreign	(403)	(486)	(419)
	4,446	5,776	12,814
Income tax expense	$ (30,157)	$ (31,601)	$ (5,471)

Reconciliation of the statutory U.S. federal tax rate to the Company's effective tax rate is as follows:

	Year ended December 31,		
	2020	2019	2018
Statutory U.S. federal income tax rate	21.0%	21.0%	21.0%
State income taxes, net of federal benefit	0.2	0.1	(0.2)
Effect of foreign operations	(5.2)	(5.4)	(4.7)
Accruals and reserves	(1.0)	(1.1)	—
Nondeductible employee compensation	2.6	2.5	1.7
Research tax credits	(1.8)	(1.4)	(2.7)
Stock based compensation	(0.9)	(1.7)	(2.7)
U.S. Tax Cuts and Jobs Act	—	—	(3.5)
U.S. International Tax (Sub F, GILTI, FDII)	3.5	3.8	(1.2)
Other	—	0.8	0.8
Effective tax rate	18.4%	18.6%	8.5%

The following table summarizes Company tax credit carry forwards for tax return purposes at December 31, 2020 (in thousands):

	Tax Benefit	Expiration Date
Tax credit carry forwards:		
State research tax credits	$ 4,560	2028 to 2035
Total credit carry forwards	$ 4,560	

Significant components of the Company's net deferred tax assets and liabilities are as follows (in thousands):

	December 31,	
	2020	2019
Deferred tax asset:		
Capitalized technology license and patents	$ 580	$ 560
Capitalized research expenditures	4,291	3,319
Accruals and reserves	4,178	4,130
Retirement plan	15,444	11,363
Deferred revenue	16,834	14,354
Tax credit carry forwards	4,589	3,997
Stock-based compensation	1,059	1,884
Other	1,914	1,682
	48,889	41,289
Valuation allowance	(4,560)	(3,368)
Deferred tax assets	44,329	37,921
Deferred tax liability:		
Accruals and reserves	(6,634)	(7,546)
Deferred tax liabilities	(6,634)	(7,546)
Net deferred tax assets	$ 37,695	$ 30,375

In assessing the realizability of deferred tax assets, management considers whether it is more likely than not that some portion or all of the deferred tax assets will not be realized. The ultimate realization of deferred tax assets is dependent on the Company's ability to generate future taxable income to obtain benefit from the reversal of temporary differences, net operating loss carryforwards and tax credits. As part of its assessment, management considers the scheduled reversal of deferred tax liabilities, projected future taxable income, and tax planning strategies. At this time there is no evidence to release the valuation allowance that has historically been recorded for the New Jersey research and development credit.

On December 27, 2018, the Korean Supreme Court, citing prior cases, held that the applicable law and interpretation of the Korea-U.S. Tax Treaty were clear that only royalties paid with respect to Korean registered patents are Korean source income and subject to Korean withholding tax. Based on this decision, the Company has decided to litigate the Korean withholding taxes paid or withheld on the 2018, 2019 and 2020 royalty payments and has engaged a leading Korean law firm which has advised that there is a more-likely-than-not chance of success. As a result, as of December 31, 2020 and 2019, the Company has recorded a long-term asset

of $40.1 million and $26.9 million, respectively, representing the allocation of withholding to non-Korean patents and a long-term liability of $32.7 million and $25.7 million, respectively, for estimated amounts due to the U.S. Federal government based on the amendment of U.S. tax returns for lower withholding amounts.

With respect to the Korean withholding for the years 2011 through 2017, the Company has decided to continue the U.S.-Korean Mutual Agreement Procedure which was accepted by the Korean National Tax Service (KNTS) on September 15, 2017. The Company believes that it is more-likely-than-not that a favorable settlement will be reached resulting in a reduction of the Korean withholding taxes previously withheld since 2011. A long-term asset of $36.9 million for estimated refunds due from the Korean government, a long-term payable of $16.2 million for estimated amounts due to the U.S. Federal government based on amendment of prior year U.S. tax returns for the lower withholding amounts, and a reduction of deferred tax assets for foreign tax credits and research and development credits of $20.7 million has been recorded on the December 31, 2020 and 2019 Consolidated Balance Sheets for this matter.

On October 30, 2018, the KNTS concluded a tax audit with LG Display that included the licensing and royalty payments made to UDC Ireland during the years 2015 through 2017. The KNTS questioned whether UDC Ireland was the beneficial owner of these payments and assessed UDC Ireland a charge of $13.2 million for withholding and interest for the three-year period. UDC Ireland has engaged a leading Korean law firm which believes it is more-likely-than-not that UDC Ireland has beneficial ownership of the underlining intellectual property. Based on this authority, UDC Ireland has paid the assessment which is recorded as a long-term asset as of December 31, 2020 and 2019. In September 2020, the Korean District Court ruled entirely in the favor of UDC Ireland on the beneficial ownership issue. However, the KNTS has decided to appeal the ruling to the Korean High Court.

The above estimates may change in the future and upon settlement.

The Company has incurred Korean withholding tax of $14.9 million for each of the years ended December 31, 2020, 2019 and 2018, which will be appealed based on the interpretation of the Korea-U.S. Tax Treaty and recent Korean Supreme Court decisions.

The Company's federal income tax returns for the years 2017 to 2020 are open and subject to examination. The State of New Jersey is currently auditing the 2014 to 2017 tax returns of UDC, Inc. The state and foreign tax returns are open for a period of generally three to four years.

19. REVENUE RECOGNITION:

Effective on January 1, 2018, the Company recognizes revenue in accordance with ASC Topic 606, *Revenue from Contracts with Customers (Topic 606)*. The standard establishes the principles that an entity shall apply to report useful information to users of financial statements about the nature, amount, timing, and uncertainty of revenue and cash flows from a contract with a customer.

During the year ended December 31, 2019, the Company entered into a transaction with one of its customers for emitters involving elements of variable consideration. Due to the escalation in trade policy tension between the governments of China and the United States, the customer required a larger than normal shipment of emitters having a right to return them through March 15, 2020 in order to accommodate their uncertain production needs. Per Topic 606, the Company was constrained to recognizing revenue on this unique shipment to the extent that it was probable that a significant revenue reversal would not occur and deferred recognition of the remainder until after the inherent uncertainties of the transaction were resolved. These uncertainties included factors that were outside of the Company's influence, including the customer's production needs and complexities associated with the current international health and trade issues in China. On March 15, 2020, the inherent uncertainties of the transaction were resolved as the customer did not exercise their right of return provision. This event resulted in the recognition of the previously constrained revenue during the year ended December 31, 2020.

For the years ended December 31, 2020, 2019 and 2018, the Company recorded 97%, 97% and 95%, respectively, of its revenue from sales of material and 3%, 3% and 5%, respectively, from the providing of services through Adesis.

Contract Balances

The following table provides information about assets and liabilities associated with our contracts from customers (in thousands):

	As of December 31, 2020
Accounts receivable	$ 82,261
Short-term unbilled receivables	6,659
Long-term unbilled receivables	3,770
Short-term deferred revenue	105,215
Long-term deferred revenue	57,086

Short-term and long-term unbilled receivables are classified as other current assets and other assets, respectively, on the Consolidated Balance Sheets. The deferred revenue balance at December 31, 2020 will be recognized as materials are shipped to customers over the remaining contract periods. The significant customer contracts (individually representing greater than 10% of revenue) expire in 2022. As of December 31, 2020, the Company had $23.9 million of backlog associated with committed purchase orders from its customers for phosphorescent emitter material. These orders are anticipated to be fulfilled within the next 90 days.

Significant changes in the unbilled receivables and deferred liabilities balances for the years ended December 31, 2020 and 2019, are as follows (in thousands):

	Year Ended December 31, 2020	
	Unbilled Receivables	Deferred Revenue
Balance at December 31, 2019	$ 1,362	$ (144,862)
Revenue recognized that was previously included in deferred revenue	—	157,704
Increases due to cash received	—	(192,369)
Cumulative catch-up adjustment arising from changes in estimates of transaction price	—	17,226
Unbilled receivables recognized	9,067	—
Net change	9,067	(17,439)
Balance at December 31, 2020	$ 10,429	$ (162,301)

	Year Ended December 31, 2019	
	Unbilled Receivables	Deferred Revenue
Balance at December 31, 2018	$ 1,020	$ (122,567)
Revenue recognized that was previously included in deferred revenue	—	133,394
Increases due to cash received	—	(157,321)
Cumulative catch-up adjustment arising from changes in estimates of transaction price	—	1,632
Unbilled receivables recognized	1,834	—
Transferred to receivables from unbilled receivables	(1,492)	—
Net change	342	(22,295)
Balance at December 31, 2019	$ 1,362	$ (144,862)

The Company recorded a cumulative catch-up adjustment arising from changes in estimates of transaction price of $17.2 million for the year ended December 31, 2020 compared to $1.6 million for the year ended December 31, 2019.

Adoption of Topic 606

The Company adopted Topic 606 beginning January 1, 2018 using the "modified retrospective" approach, meaning the standard was applied only to the most current period presented in the financial statements, with a cumulative adjustment to retained earnings. Under this transition method, the Company elected to apply Topic 606 only to contracts that were not complete at the initial adoption date. Adoption of the new standard resulted in a reduction of retained earnings of $17.1 million on January 1, 2018.

The new standard impacts how the Company recognizes revenue on its commercial license and material supply agreements with customers. Previously, the Company recognized license fees on a straight-line basis or as received from the customer, and royalty revenue one quarter in arrears based on sales information received from its customers typically received after disclosing that quarter's results. Under the new standard, total contract consideration is estimated and recognized over the contract term based on material units

sold at its estimated per unit fee. Total contract consideration includes fixed amounts designated in contracts with customers as license fees as well as estimates of material fees and royalties to be earned.

20. NET INCOME PER COMMON SHARE:

The Company computes earnings per share in accordance with ASC Topic 260, *Earnings per Share*, which requires earnings per share (EPS) for each class of stock to be calculated using the two-class method. The two-class method is an allocation of income between the holders of common stock and the Company's participating security holders. Under the two-class method, income for the reporting period is allocated between common shareholders and other security holders based on their respective participation rights in undistributed income. Unvested share-based payment awards that contain non-forfeitable rights to dividends or dividend equivalents are participating securities and, therefore, are included in computing earnings per share pursuant to the two-class method.

Basic net income per common share is computed by dividing net income allocated to common shareholders by the weighted-average number of shares of common stock outstanding for the period excluding unvested restricted stock units and performance units. Net income allocated to the holders of the Company's unvested restricted stock awards is calculated based on the shareholders proportionate share of weighted average shares of common stock outstanding on an if-converted basis.

For purposes of determining diluted net income per common share, basic net income per share is further adjusted to include the effect of potential dilutive common shares outstanding, including stock options, restricted stock units and performance units, and the impact of shares to be issued under the Employee Stock Purchase Plan.

The following table is a reconciliation of net income and the shares used in calculating basic and diluted net income per common share for the year ended December 31, 2020, 2019 and 2018 (in thousands, except share and per share data):

	Year Ended December 31,		
	2020	2019	2018
Numerator:			
Net income	$ 133,372	$ 138,304	$ 58,840
Adjustment for Basic EPS:			
Earnings allocated to unvested shareholders	(1,001)	(1,106)	(690)
Adjusted net income	$ 132,371	$ 137,198	$ 58,150
Denominator:			
Weighted average common shares outstanding – Basic	47,198,982	46,959,775	46,849,588
Effect of dilutive shares:			
Common stock equivalents arising from stock options and ESPP	1,566	1,334	1,956
Restricted stock awards and units and performance units	36,446	34,353	45,222
Weighted average common shares outstanding – Diluted	47,236,994	46,995,462	46,896,766
Net income per common share:			
Basic	$ 2.80	$ 2.92	$ 1.24
Diluted	$ 2.80	$ 2.92	$ 1.24

For the year ended December 31, 2020, 2019, and 2018, the combined effects of unvested restricted stock awards, restricted stock units, performance unit awards and stock options of none, none and 4,414, respectively, were excluded from the calculation of diluted EPS as their impact would have been antidilutive.

21. QUARTERLY SUPPLEMENTAL FINANCIAL DATA (UNAUDITED):

The following tables present certain unaudited consolidated quarterly financial information for each of the eight quarters in the two-year period ended December 31, 2020. In the opinion of Company management, this quarterly information has been prepared on the same basis as the Consolidated Financial Statements and includes all adjustments (consisting of only normal recurring adjustments) necessary to present fairly the information for the periods presented. The results of operations for any quarter are not necessarily indicative of the results for the full year or for any future period.

Presented below is a summary of the unaudited quarterly financial information for the year ended December 31, 2020 (in thousands, except per share data):

	Three Months Ended				
	March 31, 2020	June 30, 2020	September 30, 2020	December 31, 2020	Total
Revenue	$ 112,277	$ 57,968	$ 117,079	$ 141,543	$ 428,867
Net income	$ 38,155	$ 815	$ 40,500	$ 53,902	$ 133,372
Net income per common share:					
Basic	$ 0.80	$ 0.02	$ 0.85	$ 1.13	$ 2.80
Diluted	$ 0.80	$ 0.02	$ 0.85	$ 1.13	$ 2.80

Presented below is a summary of the unaudited quarterly financial information for the year ended December 31, 2019 (in thousands, except per share data):

	Three Months Ended				
	March 31, 2019	June 30, 2019	September 30, 2019	December 31, 2019	Total
Revenue	$ 87,765	$ 118,168	$ 97,515	$ 101,729	$ 405,177
Net income	$ 31,474	$ 43,440	$ 36,962	$ 26,428	$ 138,304
Net income per common share:					
Basic	$ 0.66	$ 0.92	$ 0.78	$ 0.56	$ 2.92
Diluted	$ 0.66	$ 0.92	$ 0.78	$ 0.56	$ 2.92

Per share amounts for each quarter have been calculated separately. Accordingly, quarterly amounts may not add to annual amounts.

CORPORATE HEADQUARTERS

Princeton Crossroads Corporate Center
375 Phillips Boulevard
Ewing, NJ 08618
phone: 609.671.0980
fax: 609.671.0995
www.oled.com

CORPORATE COUNSEL

Morgan, Lewis & Bockius LLP
1701 Market Street
Philadelphia, PA 19103

INDEPENDENT REGISTERED PUBLIC ACCOUNTANT

KPMG LLP
1601 Market Street
Philadelphia, PA 19103

TRANSFER AGENT & REGISTRAR

AST
6201 15th Avenue
Brooklyn, NY 11219

INQUIRIES

Inquiries concerning stock transfers, change of address and any other account questions should be directed to:

AST
6201 15th Avenue
Brooklyn, NY 11219
phone: 800.937.5449 (toll-free), 718.921.8300 (local)
email: info@astfinancial.com

All other investor inquiries should be directed to:
Universal Display Corporation
Investor Relations Department
375 Phillips Boulevard
Ewing, NJ 08618
phone: 609.964.5123
email: investor@oled.com