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, 2019

☐ **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 000-30941

AXCELIS TECHNOLOGIES, INC.
(Exact name of registrant as specified in its charter)

Delaware	**34-1818596**
(State or other jurisdiction of incorporation or organization)	(IRS Employer Identification No.)

108 Cherry Hill Drive
Beverly, Massachusetts 01915
(Address of principal executive offices) (zip code)

(978) 787-4000
(Registrant's telephone number, including area code)

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

Title of each class	Trading symbol	Name of each exchange on which registered
Common Stock, $.001 par value	ACLS	Nasdaq Global Select Market

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 checkmark whether the registrant has submitted electronically every Interactive Data File required to be submitted pursuant to Rule 405 of Regulation S-T 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 ☒	Non-accelerated filer ☐	Smaller reporting company ☐	Emerging growth company ☐

If an emerging growth company, indicate by check mark if 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 is a shell company (as defined in Rule 12b-2 of the Act). Yes ☐ No ☒

Aggregate market value of the voting stock held by non-affiliates of the registrant as of June 30, 2019: $477,385,624

Number of shares outstanding of the registrant's Common Stock, $0.001 par value, as of February 27, 2020: 33,089,192

Documents incorporated by reference:

Portions of the definitive Proxy Statement for Axcelis Technologies, Inc.'s Annual Meeting of Stockholders to be held on May 19, 2020 are incorporated by reference into Part III of this Form 10-K.

Item 1. Business.

Overview of Our Business

Axcelis Technologies, Inc. (“Axcelis,” the “Company,” “we,” “us,” or “our”) designs, manufactures and services ion implantation and other processing equipment used in the fabrication of semiconductor chips. We believe that our Purion family of products offers the most innovative implanters available on the market today. We sell to leading semiconductor chip manufacturers worldwide. The ion implantation business represented 95.1% of our revenue in 2019, with the remaining 4.9% of revenue derived from other legacy processing systems. In addition to equipment, we provide extensive aftermarket lifecycle products and services, including used tools, spare parts, equipment upgrades, maintenance services and customer training.

Axcelis’ business commenced in 1978 and its current corporate entity was incorporated in Delaware in 1995. We are headquartered in Beverly, Massachusetts and maintain an internet site at www.axcelis.com. On or through our website, investors may access, 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 Exchange Act as soon as reasonably practicable after we electronically file such material with, or furnish it to, the Securities and Exchange Commission. Our website and the information contained therein or connected thereto shall not be deemed to be incorporated into this Form 10-K.

2019 was a challenging year for the industry, with memory spending down double digits from 2018 levels. Revenue for 2019 was $343.0 million, a decrease of 22.5% from 2018 revenue of $442.6 million. Systems revenue for 2019 was $202.6 million, compared to $280.4 million in 2018. Operating profit was $24.2 million in 2019, compared to $60.0 million in 2018. Net income for the year was $17.0 million with diluted earnings per share of $0.50. This compares to 2018 net income of $45.9 million and earnings per diluted share of $1.35.

Despite lower year over year financial results, other metrics show Axcelis’ continuing improvement. 2019 marked the first time Axcelis has remained profitable through a full industry cycle. We have now achieved over 5 years of consecutive quarterly profits while making investments that put the Company in a stronger competitive position as we enter what should be a period of extended growth. A focused strategy on ion implant, combined with the hard work and dedication of our employees and the encouragement and support of our customers and suppliers, enabled us to achieve numerous critical milestones in our drive to market leadership. In 2019, we continued to expand the Purion installed base, growing our large and diverse group of customers. We also sharpened our focus on key market segments in the mature process technology areas, such as image sensors and power devices. We grew our family of Purion product extensions with the launch of four new Purion implanters specifically targeted at these segments. Through the introduction of new Purion product extensions and continuous cost out activity, we improved our gross margin year over year, making this the second consecutive year with gross margin greater than 40 percent. Additionally, we maintained a strong balance sheet free of debt and instituted a share repurchase program.

We continue to work diligently to ensure that manufacturing and operating expense levels remain well aligned to business conditions. We believe that the most fundamental interest of our stockholders is consistent, profitable, financial performance, which we expect to continue to deliver in 2020. Our performance is subject to risks and uncertainties discussed below under Item 1A Risk Factors.

Industry Overview

Semiconductor chips, also known as integrated circuits, are used in a continuously evolving range of consumer and industrial products, including for example, personal computers, mobile devices, automobiles, sensors and controllers for the “internet of things,” and data storage servers. Types of semiconductor chips include dynamic random-access memory (“DRAM”) and “negative and” (“NAND”) Flash memory; logic devices to process information; and “system on chip” devices (which have both logic and memory features). The increased number of devices providing information to and receiving information from the Internet, sometimes referred to as the “Connected World,” is increasing demand for chips. These chips are used in data input, such as image sensors, which are often manufactured using mature processing technologies, as well as for memory chips to support the storage of data, internet streaming and “cloud computing” data analytics.

Most semiconductor chips are built on silicon wafers of either 200mm (8 inches) or 300mm (12 inches) in diameter. Each semiconductor chip is made up of millions of tiny transistors or “switches” to control the functions of the device. Transistors are created in the silicon wafer by introducing various precisely placed impurities into the silicon in specific patterns.

Semiconductor chip manufacturers own or manage wafer fabrication facilities (often referred to as “fabs”), which utilize many different types of equipment in the making of integrated circuits. Over 300 process steps utilizing over 50 different types of process tools are required to make a single device like a microprocessor. Semiconductor chip manufacturers seek device performance benefits through new products and technology enhancements and productivity improvements through increased throughput, equipment utilization and higher manufacturing yields. Capacity is added by increasing the amount of manufacturing equipment in existing fabrication facilities and by constructing new fabrication facilities.

We have different types of customers, which impacts timing of purchases and technology requirements. Some customers are integrated electronics manufacturers, making semiconductor chips for their own devices. These same companies may also act as foundries, manufacturing chips for other electronic manufacturers or chip design companies. Some customers only function as foundries. A few companies design and manufacture branded chips that are sold to device manufacturers. In addition, some customers have partnerships or joint ventures with two or more semiconductor chip manufacturers to share the technology development and capital investment. The timing of purchases by foundry customers will depend on their success in securing manufacturing contracts. Also, foundry customers will look for equipment that can deliver the broadest capabilities in order to be prepared to manufacture all chip types, while integrated electronics manufacturers may invest in processing equipment dedicated to a specific application they require for their products.

The semiconductor capital equipment industry is cyclical, as global chip production capacities successively exceed, then lag behind, global chip demand. When chip demand is high, and inventories low, chip manufacturers add capacity through capital equipment purchases. Given the difficulties of forecasting and calibrating chip demand and production capacity, the industry periodically experiences excess chip inventories and softening chip prices. Device manufacturers react with muted capital spending, lowering the demand for capital equipment. Changes in consumer and business demand for products in which chips are used also affect the industry. A successful semiconductor capital equipment manufacturer must not only provide some of the most technically complex products manufactured in the world but also must manage its business to thrive during low points in the cycle.

Axcelis' Strategy

Axcelis' 2020 strategic directives are:

- Grow our Purion footprint within our existing customer base as well as at new accounts in targeted key market segments and geographies
    - Develop and support world class Purion products and technologies that align with customer roadmaps
    - Drive product differentiation resulting in productivity, cost of ownership and device performance and yield (DPY) advantages
- Drive Customer Support and Innovation (CS&I) revenues by delivering excellent customer support and innovative, high value products and services
- Meet our 2020 financial goals
    - Drive revenue growth to set up achievement of our target business models
    - Drive year over year gross margin improvement
    - Execute a capital strategy that funds appropriate investments in the business and enables the return of cash to shareholders on terms approved by the Board of Directors

We continue to invest in research and development to ensure our products meet the needs of our customers. We take pride in our scientists and engineers who are adding to our portfolio of patents and unpatented proprietary technology to ensure that our investment in technology leadership translates into unique product advantages. We strive for operational excellence by focusing on ways to lower our product, manufacturing and design costs and to improve our delivery times to our customers. Global Customer Teams and a focused account management structure maintain and strengthen our customer relationships and increase customer satisfaction. Finally, we endeavor to maintain a strong cash balance to ensure sufficient capital to fund business growth.

Ion Implantation Systems

Ion implantation is a principal step in the transistor formation cycle of the semiconductor chip manufacturing process. Ion implantation is also used to change the material characteristics of the silicon for reasons other than electrical doping, a process known as "material modification." An ion implanter is a large, technically advanced system that injects dopants such as arsenic, boron or phosphorus into a wafer. These dopants are ionized and therefore have an electrical charge state. This electric charge state allows the dopants to be accelerated, focused and filtered with electric and magnetic fields. Ion implanters use these fields to create a beam of ions with a precisely defined energy level (ranging between several hundred and eight million electron-volts) and with a precisely defined beam current level (ranging from microamps to milliamps). Certain areas of the silicon wafer are blocked off by a polymer material known as photoresist, which acts as a "stencil" to pattern devices so that the dopants will only enter the wafer where needed. Typical process flows require twenty implant steps, with the most advanced processes requiring thirty or more steps. Each implant step is characterized by four key parameters: dopant type, dose (amount of dopant), energy (depth into the silicon) and tilt/twist (angle of wafer relative to the ion beam).

In order to efficiently cover the wide range of implant steps, three different types of implanters have been developed, each targeted at a specific range of applications, primarily defined by dose and energy. The three traditional implanter types are referred to as high current, high energy and medium current:

- High current implanters were the second type of implanter to emerge, having low energy capability and high dose range.

- High energy implanters emerged to address the need for deeper implants with a high energy range and low dose.

- Medium current implanters are the original model of ion implanter, with mid to low-range energy and dose capability.

The Purion Platform and Family of Ion Implanters

Axcelis offers a complete line of high energy, high current and medium current implanters for all application requirements. Our Purion flagship systems are all based on a common platform which enables a unique combination of implant purity, precision and productivity. Combining a state-of-the-art single wafer end station, with advanced spot beam architectures (that ensures all points across the wafer see the same beam condition at the same beam angle), Purion products enable exceptional process control to optimize devise performance and yield, at high productivity.

- **High Current Implant.** Our Purion H spot beam, high current system covers all traditional high current requirements as well as those associated with emerging and future devices. Purion H capabilities extend beyond traditional high current energy and dose ranges, in order to cover new device fabrication requirements as well as to maximize capital utilization and flexibility. In addition, Purion H provides advantages for material modification applications, including those requiring hot and cold implant capabilities.

- **High Energy Implant.** Our Purion XE and other Purion high energy systems combine Axcelis' production-proven RF Linac high energy, spot beam technology with the Purion platform wafer handling system. Axcelis is a market leader in high energy ion implanters for many years and Axcelis continues to offer legacy high energy systems, as well as a range of new Purion systems which have differentiated capabilities for specialty applications.

- **Medium Current Implant.** Our Purion M medium current system offers higher productivity and lower electrical energy consumption compared to competitive offerings, in addition to other advantages. Our Purion M systems also offer differentiated capabilities for specialty applications.

We believe our ion implant products will continue to meet customer demand for advantages in productivity, process performance and technical extendibility.

Aftermarket Support and Services

Through our Customer Support and Innovation ("CS&I") business, we offer our customers extensive aftermarket service and support throughout the lifecycle of the equipment we manufacture. We believe that approximately 3,100 of our products are in use in 31 countries worldwide. The service and support that we provide includes used tools, spare parts, equipment upgrades, and maintenance services. We offer varying levels of sales, service and application support out of our field offices to customers located in 31 countries. Revenue generated through our CS&I business represented 40.9%, 36.6% and 36.0% of revenue in 2019, 2018 and 2017, respectively.

To support our aftermarket business, we have sales and marketing personnel, field service engineers, and spare parts and applications engineers, as well as employees located at our manufacturing facilities who work with our customers to provide customer training and documentation, and product, process and applications support.

Most of our customers maintain spare parts inventories for our machines. In addition to our web-based spare parts management and replenishment tracking program, we offer a number of Business-to-Business options to support our customers' parts management requirements. Our Axcelis Managed Inventory service offering provides the customer with full spares support through a parts consignment arrangement in which Axcelis retains responsibility for the complete supply chain. These services provide ease of use alternatives that reduce order fulfillment costs and improve cycle time, resulting in an expanded customer base for this service offering.

Sales and Marketing

We primarily sell our equipment and services through our direct sales force. We conduct sales and marketing activities from our sales offices located in the United States, Taiwan, South Korea, China, Germany, Singapore, Japan and Italy.

International revenue, including export sales from our U.S. manufacturing facilities to foreign customers and sales by foreign subsidiaries and branches, accounted for 89.4%, 87.7% and 84.9% of total revenue in 2019, 2018 and 2017, respectively. Substantially all of our sales are denominated in U.S. dollars. See Note 17 to our Consolidated Financial Statements contained in Item 15 of this Form 10-K for a breakdown of our revenue and long-lived assets in the United States, Europe and Asia. See also Item 1A, “Risk Factors,” for information about risks attendant to our foreign operations.

Customers

In 2019, according to Gartner Inc., the top 20 semiconductor chip manufacturers accounted for approximately 88.2% of total semiconductor capital equipment spending, down slightly from 88.8% in 2018. These manufacturers are from the largest semiconductor chip manufacturing regions in the world: the United States, Asia Pacific (Taiwan, South Korea, Singapore, Japan and China) and Europe.

Information on net sales to unaffiliated customers is included in Note 2 of Notes to Consolidated Financial Statements. For the year ended December 31, 2019, revenues from each of Samsung Electronics Co, Ltd., SK Hynix Inc. and Taiwan Semiconductor Manufacturing Company represented 10 percent or more of consolidated revenues. The loss of these customers would have a material adverse effect on our business.

Research and Development

Our industry continues to experience rapid technological change, requiring us to frequently introduce new products and enhancements. Our Beverly, Massachusetts Advanced Technology Center houses a process development laboratory with 12,500 sq. ft. of class 10/100/1000 clean room for product demonstrations and process development and a 34,000 sq. ft. customer training center. The Advanced Technology Center provides infrastructure and process capabilities that allow customers to test their unique process steps on our systems under conditions that substantially replicate the customers’ production environments. This facility also provides significant capability for our research and development efforts.

We devote a significant portion of our personnel and financial resources to research and development programs and seek to maintain close relationships with our customers to remain responsive to their product needs. We have also sought to reduce the development cycle for new products through a collaborative process whereby our engineering, manufacturing and marketing personnel work closely together with one another and with our customers at an earlier stage in the process. We use 3D, computer-aided design, finite element analysis and other computer-based modeling methods to test new designs.

Our expenses for research and development were $53.9 million, $51.9 million and $43.1 million in 2019, 2018 and 2017, respectively, or 15.7%, 11.7% and 10.5% of revenue, respectively.

Manufacturing

We manufacture products at our 417,000 sq. ft. ISO 9001:2015, ISO 14001:2015 certified plant in Beverly, Massachusetts. Our facility employs best in class manufacturing techniques, including lean manufacturing, six sigma controls and advanced inventory management, purchasing and quality systems.

Our clean manufacturing process uses class 1,000/10,000 space to facilitate most of our manufacturing requirements.

Our core competency in manufacturing and supply chain management is built around system assembly and testing, which remains an in-house capability due to the high degree of expertise and intellectual property associated with the process and design. Non-core work is sourced to one of several global partners and includes items such as vacuum systems, wafer handling and commodity-level components. We continuously pursue outsourcing opportunities where the economics are justified, with a goal of enabling quality and margin improvement. Our supply chain team is globally focused and is located in Beverly and Singapore. Customized and commercially available software solutions drive our planning, purchasing and inventory tracking process.

Our products are designed to be assembled and tested in a modular fashion, which facilitates our industry-recognized "ship-from-cell" process. Specially developed test stands, software and tooling provide the framework for this accelerated delivery process. Customers that choose ship-from-cell substantially improve their delivery times while receiving the same high level of quality provided by more traditional longer cycle integration techniques. Product margins and inventory turns also improve as a result of shorter factory cycle times and increased labor productivity.

Installation of our equipment is provided by factory and field teams. The process includes assembling the equipment at our installation site, and after it has been connected, recalibrating it to factory specifications.

Competition

The semiconductor industry is highly competitive and is characterized by a small number of participants ranging in size. Significant competitive factors in the semiconductor capital equipment market include price, cost of ownership, equipment performance, customer support, capabilities and breadth of product line.

In ion implantation, we mainly compete against Applied Materials, Inc. Axcelis and Applied Materials are the only ion implant manufacturers with a full range of implant products, as well as service and support infrastructures able to service our customers globally. Three other niche players we compete with from time to time include Advanced Ion Beam Technology, Inc., Nissin Ion Implantation Co., Ltd. and Sumitomo Heavy Industries Ion Technology Co., Ltd.

Intellectual Property

We rely on patent, copyright, trademark and trade secret protection in the United States and in other countries, as well as contractual restrictions, to protect our proprietary rights in our products and our business. As of December 31, 2019, we had 246 active patents issued in the United States and 493 active patents granted in other countries, as well as 245 patent applications (47 in the United States and 198 in other countries) on file with various patent agencies worldwide. Patents are generally in effect for up to 20 years from the filing of the application.

We intend to file additional patent applications and grow our intellectual property portfolio as appropriate. Although patents are important to our business, we do not believe that we are substantially dependent on any single patent or any group of patents.

We have trademarks, both registered and unregistered, that are maintained to provide customer recognition for our products in the marketplace. Trademark registrations generally remain in effect as long as the trademarks are in use. From time to time, we enter into license agreements with third parties under which we obtain or grant rights to patented or proprietary technology. We do not believe that any of our licenses are currently material to us.

Backlog

Systems backlog, including deferred systems revenue, was $99.3 million and $65.1 million as of December 31, 2019 and 2018, respectively. We believe it is meaningful to investors to include deferred systems revenue as part of our backlog. Deferred systems revenue represents revenue that will be recognized in future periods based on prior shipments or customer prepayments. Our policy is to include in backlog only those system orders for which we have accepted purchase orders and are typically due to ship within six months. All orders are subject to cancellations or rescheduling by customers with limited or no penalties.

Backlog does not include orders received and fulfilled within a quarter. Our backlog at the beginning of a quarter typically does not include all orders required to achieve our sales objectives for that quarter. Backlog is not necessarily an indicator of future business trends because orders for services or parts received during the quarter are generally performed or shipped within the same quarter.

Bookings in the quarter ended December 31, 2019 were $77.2 million compared to $42.1 million in the quarter ended December 31, 2018.

Employees

As of December 31, 2019, we had 960 employees and 49 temporary staff worldwide, of which 703 work in North America, 250 in Asia and 56 in Europe. We consider our relationship with our employees to be good. Our employees are not represented by a labor union and are not subject to a collective bargaining agreement. One of our European locations has formed a work council, which has certain information and discussion rights under applicable law.

Environmental

We are subject to environmental laws and regulations in the countries in which we operate that regulate, among other things: air emissions; water discharges; and the generation, use, storage, transportation, handling and disposal of solid and hazardous wastes produced by our manufacturing, research and development and sales activities. As with other companies engaged in like businesses, the nature of our operations exposes us to the risk of environmental liabilities, claims, penalties and orders.

We are proud of our commitment to improving our environment. We believe that our operations are in compliance with applicable environmental laws and regulations and that there are no pending environmental matters that would have a material impact on our business. We are ISO 9001:2015 and ISO 14001:2015 certified at our Beverly, MA facility.

Information about our Executive Officers

Mary G. Puma, 62, has been our President and Chief Executive Officer since January 2002, having served as Chairman from 2005 to 2015. From May 2000 until January 2002, Ms. Puma was our President and Chief Operating Officer. In 1998, she became General Manager and Vice President of the Implant Systems Division of Eaton Corporation, a global diversified industrial manufacturer. In May 1996, she joined Eaton as General Manager of the Commercial Controls Division. Prior to joining Eaton, Ms. Puma spent 15 years in various marketing and general management positions for General Electric Company. Ms. Puma is a director of Nordson Corporation and Semiconductor Equipment and Materials International (SEMI).

Kevin J. Brewer, 61, became our Executive Vice President and Chief Financial Officer in September 2013, having served as interim Chief Financial Officer beginning in June 2013. Mr. Brewer also manages our Global Operations. Mr. Brewer had been our Executive Vice President, Global Operations since 2008 and our Senior Vice President, Manufacturing Operations since May 2005, prior to which he had been Vice President of Manufacturing Operations since October 2002 and Director of Operations from 1999 to 2002. Prior to joining Axcelis in 1999, Mr. Brewer was Director of Operations, Business Jets at Raytheon Aircraft Company, a leading manufacturer of business and special mission aircraft owned by Raytheon Company, a manufacturer of defense, government and commercial electronics, as well as aircraft. Prior to that, Mr. Brewer held various management positions in operations and strategic planning in Raytheon Company's Electronic Systems and Missile Systems groups.

John E. Aldeborgh, 63, has been our Executive Vice President, Customer Operations since February 2013, having joined Axcelis in January 2013 as our Senior Vice President, Customer Operations. Prior to joining Axcelis, Mr. Aldeborgh served as the Chief Executive Officer and President, and as a Director, of innoPad, Inc., a privately held manufacturer of Chemical Mechanical Planarization pads, since 2006. Mr. Aldeborgh served in various marketing and sales position at Varian Semiconductor Equipment Associates Inc. (an ion implantation systems business acquired by Applied Materials Inc. in 2011) from 2002 to 2005, including Vice President of Sales and Marketing. Prior to Varian, Mr. Aldeborgh served as President and Chief Operating Officer of Ebara Technologies, Inc., from 1998 to 2002. Mr. Aldeborgh also held various positions at Genus, Inc. from 1989 to 1998, including Executive Vice President and Chief Operating Officer.

William Bintz, 63, is our Executive Vice President, Product Development since November 2016. From 2011 until November 2016, Mr. Bintz served as Executive Vice President, Product Development, Engineering and Marketing. Prior to that, he served as Senior Vice President, Marketing beginning in September 2007, after joining Axcelis in early 2006 as Director of Marketing for curing and cleaning products and shortly thereafter becoming Vice President of Product Marketing. Prior to joining Axcelis, from 2002 Mr. Bintz was Product Director for Medium Current and High Energy Ion Implant System at Varian Semiconductor Equipment Associates, Inc. Before that, he was General Manager of the Materials Delivery Products Group at MKS Instruments, beginning in 1999, and General Manager of the Thermal Processing Systems Division at Eaton Corporation (now Axcelis) beginning in 1995.

Lynnette C. Fallon, 60, is our Executive Vice President, Human Resources/Legal and General Counsel, a position she has held since May 2005. Prior to that, Ms. Fallon was Senior Vice President HR/Legal and General Counsel since 2002, and Senior Vice President and General Counsel since 2001. Ms. Fallon has also been our corporate Secretary since 2001. Before joining Axcelis, Ms. Fallon was a partner in the Boston law firm of Palmer & Dodge LLP since 1992, where she was head of the Business Law Department from 1997 to 2001.

Douglas A. Lawson, 59, has been our Executive Vice President, Corporate Marketing and Strategy since November 2013, having joined Axcelis as Vice President Business Development in 2010, and holding the position of Senior Vice President of Strategic Initiatives beginning in 2011. Mr. Lawson also manages our Information Technology function. Prior to joining the Company in 2010, he held the position of General Manager of Luminus Devices from 2009 to 2010. He has over 30 years of experience in the technology industry, and has held numerous executive and technical positions at BTU International, PRI Automation, Digital Equipment and Intel.

Russell J. Low, Ph. D., 49, is our Executive Vice President, Engineering, having joined Axcelis in October 2016. Prior to joining the Company, Dr. Low held the position of Vice President of Engineering, MOCVD Business Unit at Veeco Instruments since 2013, prior to which he was Veeco's Senior Director of Engineering, Molecular Beam Epitaxy Business Unit beginning in 2012. From 2003 to 2012, Dr. Low held a number of positions at Varian Semiconductor Equipment Associates, most recently as Director of Technology. Prior to that, Dr. Low held engineering positions in the thermal processing and ion implant divisions of Applied Materials, Inc. from 1997 to 2003.

Item 1A. Risk Factors.

Risks Related to Our Business and Industry

Set forth below and elsewhere in this Form 10-K and in other documents we file with the SEC are risks and uncertainties that could cause actual results to differ materially from the results contemplated by the forward-looking statements contained in this Form 10-K. It is not possible to predict or identify all such risk factors. Consequently, the following is not a complete discussion of all potential risks or uncertainties.

If semiconductor chip manufacturers do not make sufficient capital expenditures, our sales and profitability will be harmed.

New systems orders and used tool sales depend upon demand from semiconductor chip manufacturers who build or expand fabrication facilities. When the rate of construction or expansion of fabrication facilities declines, demand for our systems will decline, reducing our revenue. In addition, all or a portion of the demand for increased capacity may be satisfied by a semiconductor chip manufacturer's ability to reconfigure and re-use equipment they already own. Revenue decline also hurts our profitability because our established cost structure and our continued investments in engineering, research and development and marketing necessary to develop new products and to maintain extensive customer service and support capabilities limit our ability to reduce expenses in proportion to declining sales.

If we fail to develop and introduce reliable new or enhanced products and services that meet the needs of semiconductor chip manufacturers, our results will suffer.

Rapid technological changes in semiconductor chip manufacturing processes require us to respond quickly to changing customer requirements. Our future success will depend in part upon our ability to develop, manufacture and successfully introduce new systems and product lines with improved capabilities. This will depend upon a variety of factors, including new product selection, timely and efficient completion of product design and development as well as manufacturing and assembly processes, product performance in the field and effective sales and marketing. In particular:

- We must continue to develop competitive technical specifications for new systems, or enhancements to our existing systems, and manufacture and ship these systems or enhancements in volume in a timely manner.

- We will need to accurately predict the schedule on which our customers will be ready to transition to new products, in order to accurately forecast demand for new products while managing the transition from older products.

- We will need to effectively manage product reliability or quality problems that often exist with new systems, in order to avoid higher manufacturing costs, delays in acceptance and payment and additional service and warranty expenses, and ultimately, a lack of repeat orders.

- Our new products must be accepted in the marketplace.

Our failure to meet any of these requirements will have a material adverse effect on our operating results and profitability.

A significant portion of our revenue depends on customers electing to buy aftermarket products and services from Axcelis.

Historically, a significant portion of our product revenue and all of our service revenue relates to our sale of "aftermarket" products and services, which include parts, consumables, upgrades, service contracts, and time and materials billings. Some of our customers purchase fewer aftermarket products and services, often training their own staff to maintain and service semiconductor capital equipment rather than relying on the equipment manufacturer for these services. In addition, we compete against third party parts suppliers for the sale of parts and consumables that are not protected by patents or otherwise proprietary. To the extent our customers purchase parts and services from other vendors or provide their own system maintenance labor, our revenue and profitability will be less.

If we fail to compete successfully in the highly competitive semiconductor capital equipment industry, our sales and profitability will decline.

The ion implant segment is highly competitive and includes one company with substantially greater financial, engineering, manufacturing, marketing and customer service and support resources that may better position it to compete successfully, as well as several smaller companies that could provide innovative systems with technology that may have performance advantages. We expect our competitors to continue to improve the design and performance of their existing products and processes and to introduce new products and processes with improved price and performance characteristics. If we are unable to improve or introduce competing products when demanded by the markets, our business will be harmed. Finally, if we must lower prices to remain competitive without commensurate cost of goods savings, our gross margin and profitability will be adversely affected.

We are dependent on sales to a limited number of large customers; the loss of a significant customer or any reduction in orders from them could materially affect our sales.

Historically, we have sold a significant portion of our products and services to a limited number of semiconductor chip manufacturers. In 2019, our top ten customers accounted for 74.1% of our net sales, in comparison to 76.9% and 73.3% in 2018 and 2017, respectively. None of our customers have entered into a long-term agreement requiring it to purchase our products. Although the composition of the group comprising our largest customers has varied from year to year, the loss of a significant customer or any reduction or delays in orders from any significant customer will adversely affect us. Consolidation of semiconductor chip manufacturers may result in the loss of a customer.

Axcelis is subject to the risks of operating internationally: we derive a substantial portion of our revenue from outside the United States, especially from Asia.

We are substantially dependent on sales of our products and services to customers outside the United States. International sales, including export sales from our U.S. manufacturing facilities to non-U.S. customers and sales by our non-U.S. subsidiaries, accounted for 89.4% of total revenue in 2019. Asia dominates our international sales. Ion implanter system shipments to Asian customers represented 87.7% of total system shipment dollars in 2019. We anticipate that international sales will continue to account for a significant portion of our revenue. In particular, we expect that sales to China will continue to increase in coming years, creating both risk and opportunity. China represents a higher risk than some other international locations because of trade tensions with the United States, and other challenges reflecting China's stage of development, including public health concerns and rapid growth. We also source a substantial portion of our materials from outside of the United States. Because of our dependence upon international sales and our global supply chain, our results and prospects may be adversely affected by a number of factors, including:

- unexpected changes in laws or regulations resulting in more burdensome governmental controls, tariffs, restrictions, embargoes or export license requirements;
- volatility in currency exchange rates;
- political and economic instability;
- global health emergency (for example in early 2020, a novel coronavirus, COVID-19, was diagnosed in China and has spread globally. Axcelis has both customers and suppliers in regions currently affected by the virus. We have put policies in place to safeguard our employees while continuing to serve our customers. The extent of the outbreak and its impact on our operations is uncertain. This is a rapidly changing situation which could materially impact our business and results of operations.);
- difficulties in accounts receivable collections;
- extended payment terms beyond those customarily offered in the United States;

- difficulties in managing suppliers, service providers or representatives outside the United States;
- difficulties in staffing and managing foreign subsidiary operations; and
- potential adverse tax consequences.

Our dependence upon suppliers for many components and sub-assemblies could result in increased costs or delays in the manufacture and sale of our products.

We rely to a substantial extent on outside vendors to manufacture many of the components and sub-assemblies of our products. We obtain many of these components and sub-assemblies from a limited group of suppliers. Accordingly, based on situations outside of our control, we may be unable to obtain an adequate supply of required components on a timely basis, on price and other terms acceptable to us, or at all. In addition, we often quote prices to our customers and accept customer orders for our products before purchasing components and sub-assemblies from our suppliers. If our suppliers increase the cost of components or sub-assemblies, we may not have alternative sources of supply and may not be able to raise the price of our products to cover all or part of the increased cost of components, negatively impacting our gross margin.

The manufacture of some of these components and sub-assemblies is an extremely complex process and requires long lead times. As a result we could experience delays or shortages. If we are unable to obtain adequate and timely deliveries of our required components or sub-assemblies, we may have to seek alternative sources of supply or manufacture these components internally. This could delay our ability to manufacture or to ship our systems on a timely basis, causing us to lose sales, incur additional costs, delay new product introductions and suffer harm to our reputation.

Moreover, if actual demand for Axcelis' products is different than expected, Axcelis may purchase more or fewer parts than necessary or incur costs for canceling, postponing or expediting delivery of parts. If Axcelis purchases inventory in anticipation of customer demand that does not materialize, or if customers reduce or delay orders, Axcelis may incur excess inventory charges.

Our international operations involve currency risk.

Substantially all of our sales are billed in U.S. dollars, thereby reducing the impact of fluctuations in foreign exchange rates on our results. We also pay almost all non-US vendors providing materials, components and subassemblies to our U.S. factory in U.S. dollars. However, the aftermarket revenues of our non-U.S. subsidiaries, and most of the operating expenses of these non-U.S. subsidiaries, are received and incurred in local currencies. The translation of these operating results into U.S. dollars in our Consolidated Statement of Operations can result in other income (expense). Similarly, the translation of long-term asset and liability values to U.S. dollars are recorded in stockholders' equity as an element of accumulated other comprehensive income (loss). Accordingly, fluctuations in exchange rates can impact reported revenues, expense, and profitability and asset values in our Consolidated Financial Statements. During the year ended December 31, 2019, approximately 25.3% of our revenue was derived in local currencies from foreign operations with this inherent risk. In addition, at December 31, 2019, our operations outside of the United States accounted for approximately 13.4% of our total assets, the majority of which was denominated in currencies other than the U.S. dollar.

We may not be able to maintain and expand our business if we are not able to hire, retain and integrate qualified personnel.

Our business depends on our ability to attract and retain qualified, experienced employees. There is substantial competition for experienced engineering, technical, financial, sales and marketing personnel in our industry. In particular, we must attract and retain highly skilled design and process engineers. Competition for such personnel is intense, particularly in the Boston metropolitan area, as well as in other locations around the world. If we are unable to retain our existing key personnel, or attract and retain additional qualified personnel, we may from time to time experience insufficient levels of staffing to fully develop, manufacture and market our products and perform services for our customers. As a result, our growth could be limited or we could fail to meet our delivery commitments or experience deterioration in service levels or decreased customer satisfaction, all of which could adversely affect our financial results.

Our financial results may fluctuate significantly.

We derive our new systems revenue from the sale of a small number of expensive products to a relatively small number of customers. The selling prices on our ion implant and other legacy processing systems range from approximately $2.0 million to $8.0 million. We also sell used equipment in our aftermarket business. Each sale, or failure to make a sale, may have a significant effect on us in a particular quarter. In a given quarter, a number of factors can adversely affect our revenue and results, including changes in our product mix, increased fixed expenses per unit due to reductions in the number of products manufactured, and higher fixed costs due to increased levels of research and development and expansion of our worldwide sales and marketing organization. Our financial results also fluctuate based on gross profit realized on sales. A variety of factors may cause gross profit as a percentage of revenue to vary, including the mix and average selling prices of products sold, costs to manufacture and customize systems, warranty costs and impact of changes to inventory reserves. New product introductions may also affect our gross margin. Fluctuations in our financial results may have an adverse effect on the price of our common stock.

Our financial results may fall short of anticipated levels because forecasting revenue and profitability is complex and may be inaccurate.

Management may from time to time provide financial forecasts to investors. These forecasts are based on assumptions, which are believed to be reasonable when made, of the timing of system orders, system shipments, system acceptance and aftermarket revenue. Any of these assumptions can prove erroneous and the level of revenue recognizable in a particular quarter may vary from the forecast. Our lengthy sales cycle, coupled with customers' competing capital budget considerations, make revenue difficult to predict. In addition, our backlog at the beginning of a quarter typically does not include all orders required to achieve our sales objectives for that quarter and is not a reliable indicator of our future sales. As a result, our revenue and operating results for a quarter depend on our shipping systems on previous orders as scheduled during that quarter, receiving customer acceptance of previously shipped products, and obtaining new orders for products and services to be provided within that same quarter. Any delay in, or cancellation of, scheduled shipments and customer acceptances or in revenue from new orders, including aftermarket revenue, could materially affect our financial results.

Accounting rules addressing revenue recognition add more complexity in forecasting quarterly revenue and profitability. Orders for our products usually contain multiple performance obligations that result in revenue deferral under generally accepted accounting principles. Due to the foregoing factors, investors should understand that our actual financial results for a quarter may vary significantly from our forecasts of financial performance for that quarter. Failure to meet forecasted financial performance may have an adverse effect on the price of our common stock.

The semiconductor industry is cyclical and we expect that demand for our products will increase and decrease, making it difficult to manage the business and potentially causing harm to our sales and profitability.

The semiconductor industry is cyclical, experiencing upturns when the demand for our products is high and downturns when our customers are not investing in new or expanded fabrication facilities. From time to time, inventory buildups in the semiconductor industry produce an oversupply of semiconductors. This can cause a reduced demand for capital equipment such as our products, negatively impacting our sales and level of profitability. Our revenue can vary significantly from one point in the cycle to another, making it difficult to manage the business, both when revenue is increasing and when it is decreasing. In addition, a substantial portion of our operating expenses do not fluctuate with changes in volume. Significant decreases in revenue can therefore have a disproportionate effect on profitability. In addition, reduced demand for our products and services may require Axcelis to implement cost reduction efforts, including restructuring activities, which may adversely affect Axcelis' ability to capitalize on opportunities that arise in the future.

Axcelis is exposed to risks related to cybersecurity threats and incidents.

In the conduct of our business, Axcelis collects, uses, transmits and stores data on information technology systems. This data includes confidential information belonging to Axcelis, our employees or our customers or other business partners, some of which is personally-identifiable information of individuals. As reported in the 2017 Verizon Data Breach Investigation Report, cyber-attacks in the manufacturing industries are largely financially motivated, although business espionage is the objective in a strong majority of the incidents. Axcelis has been and expects to be subject to cybersecurity threats and incidents, including employee error or misuse; individual attempts to gain unauthorized access to information systems; and sophisticated and targeted measures known as advanced persistent threats, none of which have had a material impact on the Company to date. Axcelis devotes significant resources to network security, data encryption, employee training and other measures to protect our systems and data from unauthorized access or misuse. However, depending on their nature and scope, cybersecurity incidents could result in business disruption; the misappropriation, corruption or loss of confidential information and critical data (Axcelis' and that of third parties); reputational damage; unnecessary expense; litigation with third parties; diminution in the value of Axcelis' investment in research, development and engineering; data privacy issues; and increased cybersecurity protection and remediation costs. These adverse outcomes could negatively impact our revenues, expenses, profitability and asset values.

Axcelis is subject to risks associated with environmental, health and safety regulations.

Axcelis is subject to environmental, health and safety regulations in connection with its global business operations, including but not limited to: regulations related to the development, manufacture, shipping and use of its products; handling, discharge, recycling and disposal of hazardous materials used in its products or in producing its products; the operation of its facilities; and the use of its real property. The failure or inability to comply with existing or future environmental and safety regulations could result in: significant remediation or other legal liabilities; the imposition of penalties and fines; restrictions on the development, manufacture, sale, shipment or use of certain of its products; limitations on the operation of its facilities or ability to use its real property; and a decrease in the value of its real property. Axcelis could be required to alter its manufacturing and operations and incur substantial expense in order to comply with environmental, health and safety regulations. Any failure to comply with these regulations could subject Axcelis to significant costs and liabilities that could adversely affect Axcelis' business, financial condition and results of operations.

Our proprietary technology may be vulnerable to efforts by competitors to challenge or design around, potentially reducing our market share.

We rely on a combination of patents, copyrights, trademark and trade secret laws, non-disclosure agreements and other intellectual property protection methods to protect our proprietary technology. Despite our efforts to protect our intellectual property, our competitors may be able to challenge, design around or legitimately use the proprietary technology embedded in our systems or other technology or information used in our business. If this occurs, the value of our proprietary technology will be diminished. Our means of protecting our proprietary rights may not be adequate and our patents may not be sufficient to prevent others from using technology that is similar to or the same as our technology. Patents issued to us may be challenged and might be invalidated or circumvented and any rights granted under our patents may not provide adequate protection to us. Our competitors may independently develop similar technology, duplicate features of our products or design around patents that may be issued to us. As a result of these threats to our proprietary technology, we may have to resort to costly litigation to enforce or defend our intellectual property rights. Finally, all patents expire after a period of time (in the U.S., patents expire 20 years from the date of filing of the patent application). Our market share could be negatively impacted by the invalidation or expiration of a patent which had created a barrier for our competitors.

Axcelis also has agreements with third parties for licensing of patented or proprietary technology with Axcelis as the licensor or the licensee. Termination of license agreements or claims of infringement with respect to such technology could have an adverse impact on our financial performance or ability to ship products with existing configurations.

We (or customers that we indemnify) might face intellectual property infringement claims or patent disputes that may be costly to resolve and, if resolved against us, could be very costly to us and prevent us from making and selling our systems.

From time to time, claims and proceedings may be asserted against us relative to patent validity or infringement matters. We typically agree to indemnify our customers from liability to third parties for intellectual property infringement arising from the use of our products in their intended manner. Therefore, we may receive notification from customers who believe that we owe them indemnification or other obligations related to infringement claims made against the customers by third parties. Our involvement in any patent dispute or other intellectual property dispute or action to protect trade secrets, even if the claims are without merit, could be very expensive and could divert the attention of our management. Adverse determinations in any litigation could subject us to significant liabilities to third parties, require us to remove certain features from our products or seek costly licenses from third parties or prevent us from manufacturing and selling our systems. In addition, infringement indemnification clauses in system sale agreements may require us to take other actions or require us to provide certain remedies to customers who are exposed to indemnified liabilities. Any of these situations could have a material adverse effect on our business results.

If operations were disrupted at Axcelis' primary manufacturing facility, it would have a negative impact on our business.

We have one primary manufacturing facility located in Massachusetts. Our operations could be subject to disruption for a variety of reasons, including, but not limited to natural disasters, work stoppages, operational facility constraints and terrorism. Such disruption could cause delays in shipments of products to our customers and could result in cancellation of orders or loss of customers, which could seriously harm our business.

If we do not have access to capital on favorable terms, on the timeline we anticipate, or at all, our financial condition and results of operations could be materially adversely affected.

We require a substantial amount of capital to meet our operating requirements and remain competitive. We routinely incur significant costs to purchase inventory to meet expected system sales, to develop and introduce new products, and to place evaluation systems at new customer sites. Our Board has also authorized management to repurchase shares of our common stock under a stock repurchase program. There can be no assurance that we will realize a return on the capital expended. Although our current cash levels are expected to be adequate for our foreseeable cash requirements, if our operating results falter, or our cash flow or capital resources prove inadequate, we may incur debt to fund these requirements. Significant volatility or disruption in the global financial markets may result in us not being able to obtain additional financing on favorable terms, on the timeline we anticipate, or at all, and we may not be able to refinance, if necessary, any outstanding debt when due, all of which could have a material adverse effect on our financial condition. Any inability to obtain funding on favorable terms, on the timeline we anticipate, or at all, may cause us to curtail our operations significantly, reduce planned capital expenditures and research and development, or obtain funds through arrangements that management does not currently anticipate, including disposing of our assets and relinquishing rights to certain technologies, the occurrence of any of which may significantly impair our ability to remain competitive, and materially and adversely affect our results of operations and financial condition.

The market price of our common stock may be volatile, which could result in substantial losses for investors.

The stock markets in general, and the markets for semiconductor equipment stocks in particular, have experienced extreme volatility that has often been unrelated to the operating performance of particular companies. These broad market fluctuations may adversely affect the trading price of our common stock. The market price of the common stock may also fluctuate significantly in response to the following factors, among others, some of which are beyond our control:

- variations in our quarterly results;
- the issuance or repurchase of shares of our common stock;
- changes in securities analysts' estimates of our financial performance;
- changes in market valuations of similar companies;

- announcements by us or our competitors of significant contracts, acquisitions, strategic partnerships, joint ventures, capital commitments, new products or product enhancements;
- loss of a major customer or failure to complete significant transactions;
- additions or departures of key personnel; and
- unfavorable new positions adopted by investor stewardship groups and proxy advisory firms regarding desired environmental, social and governance disclosures, policies, ranking systems and other initiatives.

The trading price of our common stock in the past has had significant volatility, and we cannot accurately predict every potential risk that may materially and adversely affect our stock price.

Item 1B. Unresolved Staff Comments.

None.

Item 2. Properties.

We lease our principal facility in Beverly, Massachusetts, which comprises 417,000 square feet. The facility is principally used for manufacturing, research and development, sales/marketing, customer support, advanced process development, product demonstration, customer-training center and corporate headquarters. We believe that our manufacturing facilities and equipment generally are well maintained, in good operating condition, suitable for our purposes, and adequate for our present operations.

We own 23 acres of undeveloped property in Beverly, Massachusetts, adjacent to our headquarters.

As of December 31, 2019, we also leased 47 other properties, of which 10 are located in the United States and the remainder are located in Asia and Europe, including offices in Taiwan, Singapore, South Korea, China, Japan, Italy and Germany. These properties are used for sales and service offices and warehousing.

Our Beverly, Massachusetts facility is ISO 9001:2015 and ISO 14001:2015 and our European office is ISO 9001:2015 certified.

Item 3. Legal Proceedings.

We are not presently a party to any litigation that we believe might have a material adverse effect on our business operations. We are, from time to time, a party to litigation that arises in the normal course of our business operations.

Item 4. Mine Safety Disclosures.

Not applicable.

Item 5. Market for Registrant's Common Equity, Related Stockholder Matters and Issuer Purchases of Equity Securities.

Our common stock trades on the Nasdaq Global Select Market under the symbol ACLS. As of February 27, 2020, we had approximately 1,400 stockholders of record.

The following table summarizes the stock repurchase activity for the 12 months ended December 31, 2019 and the approximate dollar value of shares that may yet be purchased pursuant to our stock repurchase program:

	Total Number of Shares Purchased	Average Price Paid per Share	Total Number of Shares Purchased as Part of Publicly Announced Program*	Approximate Dollar Value of Shares that May Yet Be Purchased Under the Program
	(in thousands except per share amounts)			
May 1, 2019 through May 31, 2019	642	$16.23	642	$ 39,577
June 1, 2019 through June 30, 2019	243	$14.87	243	35,965
November 1, 2019 through November 30, 2019	52	$21.89	52	34,839
December 1, 2019 through December 31, 2019	115	$22.39	115	$ 32,256
Total	1,052		1,052	

* In December 2019, we announced that our Board of Directors extended and increased the stock repurchase program, authorizing up to $50 million share repurchase through the end of 2020. As of December 31, 2019, $32.3 million remained available for stock repurchases pursuant to this program.

The pace of our repurchase activity will depend on factors such as our working capital needs, our cash requirements for business development, our stock price, and economic and market conditions. Our stock repurchases may be effected from time to time through open market purchases or pursuant to a Rule 10b5-1 plan. Our stock repurchase program may be accelerated, suspended, delayed or discontinued at any time.

The remainder of the information required by Item 5 of Form 10-K is incorporated by reference to the information responsive thereto contained in the section of the Axcelis Proxy Statement for the Annual Meeting of Stockholders to be held May 19, 2020 captioned "Proposal 2: Approval of the 2020 Employee Stock Purchase Plan – Current Equity Compensation Plan Information."

Item 6. Selected Financial Data.

The following selected consolidated statements of operations data for each of the three years ended December 31, 2019, 2018 and 2017 and the consolidated balance sheets data as of December 31, 2019 and 2018 have been derived from the audited consolidated financial statements contained in Item 15 of Part IV of this Form 10-K. The selected consolidated balance sheets data as of December 31, 2017 and 2016, and the statements of operations data for the years ended December 31, 2016 and 2015, have been derived from the audited financial statements contained in our Form 10-K filed on March 14, 2018. The consolidated balance sheets data as of December 31, 2015 have been derived from the audited financial statements contained in our Form 10-K filed on March 14, 2017.

The historical financial information set forth below may not be indicative of our future performance and should be read together with "Management's Discussion and Analysis of Financial Condition and Results of Operations" and our historical consolidated financial statements and notes to those statements included in Item 7 of Part II and Item 15 of Part IV, respectively, of this Form 10-K.

	Year ended December 31,				
	2019	2018	2017	2016	2015
	(In thousands, except per share amounts)				
Consolidated statements of operations data:					
Revenue	$ 342,958	$ 442,575	$ 410,561	$ 266,980	$ 301,495
Gross profit	144,152	179,636	150,247	99,598	101,706
Income from operations	24,205	59,959	47,842	16,623	20,718
Income before income taxes	20,922	54,705	43,831	11,024	15,205
Net income	17,034	45,885	126,959	11,001	14,678
Net income per share:					
Basic	$ 0.52	$ 1.42	$ 4.11	$ 0.38	$ 0.51
Diluted	$ 0.50	$ 1.35	$ 3.80	$ 0.36	$ 0.49
Shares used in computing basic and diluted per share amounts:					
Basic	32,559	32,286	30,866	29,195	28,595
Diluted	33,828	34,002	33,436	30,947	30,229
Consolidated balance sheets data:					
Cash and cash equivalents	$ 139,881	$ 177,993	$ 133,407	$ 70,791	$ 78,889
Working capital	307,015	311,774	260,488	192,998	185,589
Total assets	548,094	548,441	488,218	302,231	281,784
Long-term liabilities	60,003	55,107	55,321	53,045	53,652
Stockholders’ equity	419,427	408,337	353,610	201,455	183,764

Item 7. Management's Discussion and Analysis of Financial Condition and Results of Operations.

Certain statements in "Management's Discussion and Analysis of Financial Condition and Results of Operations" are forward-looking statements that involve risks and uncertainties. Words such as may, will, should, would, anticipates, expects, intends, plans, believes, seeks, estimates and similar expressions identify such forward-looking statements. The forward-looking statements contained herein are based on current expectations and entail various risks and uncertainties that could cause actual results to differ materially from those expressed in such forward-looking statements. Factors that might cause such a difference include, among other things, those set forth under "Liquidity and Capital Resources" and "Risk Factors" and others discussed elsewhere in this Form 10-K. Readers are cautioned not to place undue reliance on these forward-looking statements, which reflect management's analysis only as of the date hereof. We assume no obligation to update these forward-looking statements to reflect actual results or changes in factors or assumptions affecting forward-looking statements, except as may be required by law.

Overview

The semiconductor capital equipment industry is subject to cyclical swings in capital spending by semiconductor chip manufacturers. Capital spending is influenced by demand for semiconductors and the products using them, the utilization rate and capacity of existing semiconductor chip manufacturing facilities and changes in semiconductor technology, all of which are outside of our control. As a result, our revenue may fluctuate from year to year and period to period. Our established cost structure does not vary significantly with changes in volume. We may also experience fluctuations in operating results and cash flows depending on our revenue level.

2019 was a challenging year for the industry, with memory spending remaining low throughout the year. Revenue for 2019 was $343.0 million, a decrease of 22.5% from 2018 revenue of $442.6 million. Systems revenue for 2019 was $202.6 million, compared to $280.4 million in 2018. Operating profit was $24.2 million in 2019, compared to $60.0 million in 2018. Net income for the year was $17.0 million with diluted earnings per share of $0.50. This compares to 2018 net income of $45.9 million and earnings per diluted share of $1.35.

Despite lower year over year financial results, other metrics show Axcelis' continuing improvement. 2019 marked the first time Axcelis has remained profitable through a full industry cycle. We have now achieved over 5 years of consecutive quarterly profits while making investments that put the Company in a stronger competitive position as we enter what should be a period of extended growth. A focused strategy on ion implant, combined with the hard work and dedication of our employees and the encouragement and support of our customers and suppliers, enabled us to achieve numerous critical milestones in our drive to market leadership. In 2019, we continued to expand the Purion installed base, growing our large and diverse group of customers. We also sharpened our focus on key market segments in the mature process technology areas, such as image sensors and power devices. We grew our family of Purion product extensions with the launch of four new Purion implanters specifically targeted at these segments. Through the introduction of new Purion product extensions and continuous cost out activity, we improved our gross margin year over year, making this the second consecutive year with gross margin greater than 40 percent. Additionally, we maintained a strong balance sheet free of debt and instituted a share repurchase program.

We continue to work diligently to ensure that manufacturing and operating expense levels remain well aligned to business conditions.

The market for our systems and aftermarket products and services is represented by a relatively small number of companies. In 2019, the top 20 semiconductor chip manufacturers accounted for approximately 88.2% of total semiconductor capital equipment spending, down from 88.8% in 2018. Our net revenue from our ten largest customers accounted for 74.1% of total revenue for the year ended December 31, 2019 compared to 76.9% and 73.3% of revenue for the years ended December 31, 2018 and 2017, respectively. For the year ended December 31, 2019, we had three customers representing 18.2%, 14.2% and 12.0% of total revenue, respectively.

Critical Accounting Estimates

Management's discussion and analysis of our financial condition and results of operations are based upon Axcelis' consolidated financial statements, which have been prepared in accordance with accounting principles generally accepted in the United States. The preparation of these financial statements requires management to make estimates and judgments that affect the reported amounts of assets, liabilities, revenue and expenses, and related disclosure of contingent assets and liabilities. On an on-going basis, we evaluate our estimates and assumptions. Management's estimates are based on historical experience and on various other assumptions that are believed to be reasonable under the circumstances, the results of which form the basis for making judgments about the carrying values of assets and liabilities that are not readily apparent from other sources. Actual results may differ from these estimates under different assumptions or conditions.

We believe the following accounting policies are critical in the portrayal of our financial condition and results of operations and require management's most significant judgments and estimates in the preparation of our consolidated financial statements. For additional accounting policies, see Note 2 to the consolidated financial statements for the year ended December 31, 2019 included in this Annual Report on Form 10-K.

Revenue Recognition

Our accounting policies relating to the recognition of revenue require management to make estimates, determinations and judgments based on historical experience and on various other assumptions, which include (i) the existence of a contract with the customer, (ii) the identification of the performance obligations in the contract, (iii) the value of any variable consideration in the contract, (iv) the standalone selling price of multiple obligations in the contract, for the purpose of allocating the consideration in the contract, and (v) determining when a performance obligation has been met. Our revenue recognition policies are set forth in section (i) of Note 2, Summary of Significant Accounting Policies, to the consolidated financial statements for the year ended December 31, 2019 included in this Annual Report on Form 10-K. Recognition of revenue based on incorrect judgments, including an erroneous allocation of the estimated sales price between the units of accounting, could result in inappropriate recognition of revenue, or incorrect timing of revenue recognition, which could have a material effect on our financial condition and results of operations.

Inventory—Provision for Excess and Obsolescence and Lower of Cost or Net Realizable Value

We record a provision for estimated excess and obsolete inventory and lower of cost or net realizable value. The provision is determined using management's assumptions of materials usage, based on estimates of forecasted and historical demand and market conditions. Specifically, our assumptions of forecasted system sales and the size and utilization of the installed base of systems may have a significant effect on estimated materials usage. If actual market conditions become less favorable than those projected by management, additional inventory write-downs may be required.

Although we make every effort to ensure the accuracy of our forecasts or product demand and pricing assumptions, any significant unanticipated changes in demand, pricing, or technical developments would significantly impact the value of our inventory and our reported operating results. In the future, if we determine that inventory needs to be written down, we will recognize such costs in our cost of revenue at the time of such determination. If we subsequently sell product that has previously been written down, our gross margin in that period will be favorably impacted.

Product Warranty

We generally offer a one year warranty for all of our systems, the terms and conditions of which vary depending upon the product sold. For all systems sold, we accrue a liability for the estimated cost of standard warranty at the time of system shipment and defer the portion of systems revenue attributable to the relative fair value of non-standard warranty. Costs for non-standard warranty are expensed as incurred. Factors that affect our warranty liability include the number of installed units, historical and anticipated product failure rates, material usage and service labor costs. We periodically assess the adequacy of our recorded liability and adjust the amount as necessary.

Income Taxes

We record income taxes using the asset and liability method. Deferred income 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 income tax basis, and net operating loss and tax credit carryforwards.

Our consolidated financial statements contain certain deferred tax assets which have arisen primarily as a result of operating losses, as well as other temporary differences between financial and income tax accounting.

We establish a valuation allowance when it is more likely than not that some portion or all of the deferred tax assets will not be realized. Significant management judgment is required in determining our provision for income taxes, the deferred tax assets and liabilities and any valuation allowance recorded against those net deferred tax assets.

We evaluate the weight of all available evidence such as historical losses, the expected timing of the reversals of existing temporary differences and projected future taxable income to determine whether it is more likely than not that some portion or all of the net deferred income tax assets will not be realized.

Our income tax expense includes the largest amount of tax benefit for an uncertain tax position that is more likely than not to be sustained upon audit based on the technical merits of the tax position. Settlements with tax authorities, the expiration of statutes of limitations for particular tax positions, or obtaining new information on particular tax positions may cause a change to the effective tax rate. We recognize accrued interest related to unrecognized tax benefits as interest expense and penalties as operating expense.

Results of Operations

The following table sets forth our results of operations as a percentage of total revenue:

	Year ended December 31,		
	2019	2018	2017
Revenue:			
Product	93.2 %	94.0 %	94.3 %
Services	6.8	6.0	5.7
Total revenue	100.0	100	100
Cost of revenue:			
Product	51.2	53.4	57.2
Services	6.7	6.0	6.2
Total cost of revenue	57.9	59.4	63.4
Gross profit	42.1	40.6	36.6
Operating expenses:			
Research and development	15.7	11.7	10.5
Sales and marketing	10.0	7.8	6.9
General and administrative	9.3	7.5	7.5
Total operating expenses	35.0	27.0	24.9
Income from operations	7.1	13.6	11.7
Other (expense) income:			
Interest income	0.9	0.5	0.2
Interest expense	(1.5)	(1.2)	(1.3)
Other, net	(0.3)	(0.6)	0.1
Total other expense	(0.9)	(1.3)	(1.0)
Income before income taxes	6.2	12.3	10.7
Income tax provision (benefit)	1.1	1.9	(20.2)
Net income	5.1 %	10.4 %	30.9 %

Revenue

The following table sets forth our revenue:

	Year ended December 31,		Period-to-Period Change		Year ended December 31,		Period-to-Period Change	
	2019	2018	$	%	2018	2017	$	%
	(dollars in thousands)							
Revenue:								
Product	$ 319,505	$ 415,922	*$ (96,417)*	*(23.2)%*	$ 415,922	$ 387,124	*$ 28,798*	*7.4 %*
Percentage of revenue	*93.2 %*	*94.0 %*			*94.0 %*	*94.3 %*		
Services	23,453	26,653	*(3,200)*	*(12.0)%*	26,653	23,437	*3,216*	*13.7 %*
Percentage of revenue	*6.8 %*	*6.0 %*			*6.0 %*	*5.7 %*		
Total revenue	$ 342,958	$ 442,575	$ (99,617)	*(22.5)%*	$ 442,575	$ 410,561	$ 32,014	*7.8 %*

2019 Compared with 2018

Product

Product revenue, which includes new system sales, sales of spare parts, product upgrades and used system sales was $319.5 million or 93.2% of revenue in 2019, compared with $415.9 million, or 94.0% of revenue in 2018. The decrease in product revenue in 2019 was primarily driven by a decrease in the number of Purion systems sold.

A portion of our revenue from system sales is deferred until installation and other services related to future deliverables are performed. The total amount of deferred revenue at December 31, 2019 and 2018 was $29.3 million and $22.6 million, respectively. The increase was primarily due to an increase in system prepayments in the current year.

Services

Services revenue, which includes the labor component of maintenance and service contracts and fees for service hours provided by on-site service personnel, was $23.5 million, or 6.8% of revenue for 2019, compared with $26.7 million, or 6.0% of revenue for 2018. Although services revenue should increase with the expansion of the installed base of systems, it can fluctuate from period to period based on capacity utilization at customers' manufacturing facilities, which affects the need for equipment service.

2018 Compared with 2017

Product

Product revenue was $415.9 million or 94.0% of revenue in 2018, compared with $387.1 million, or 94.3% of revenue in 2017. The increase in product revenue in 2018 was primarily driven by an increase in the number of Purion systems sold.

The total amount of deferred revenue at December 31, 2018 and 2017 was $22.6 million and $18.1 million, respectively. The increase was primarily due to the increased number of systems sold in the current year.

Services

Services revenue was $26.7 million, or 6.0% of revenue for 2018, compared with $23.4 million, or 5.7% of revenue for 2017.

Revenue Categories used by Management

In addition to the line item revenue categories discussed above, management also uses revenue categorizations which break down revenue into other groupings. Management regularly disaggregates revenue in the following categories, which it finds relevant and useful:

- Ion implant revenue separate from revenue from legacy non-implant product lines, given that ion implantation systems are critical to our growth and strategic objectives;

- Systems and aftermarket revenues, in which "Aftermarkets" is
    - A. the portion of Product revenue relating to spare parts, product upgrades and used systems combined with
    - B. Service revenue, which is the labor component of aftermarket revenues;

  Aftermarket purchases reflect current fab utilization as opposed to System purchases which reflect capital investment decisions by our customers, which have differing economic drivers;

- Revenue by geographic regions, since economic factors impacting customer purchasing decisions may vary by geographic region; and

- Revenue by our customers’ end markets, since they tend to be subject to different economic environments at different periods of time, impacting a customer’s likelihood of purchasing capital equipment during any particular period; currently, management uses three end market categories: Memory, mature technology processes and leading edge foundry and logic.

The ion implant and aftermarket revenue categories for recent periods are discussed below.

2019 Compared with 2018

Ion Implant

Revenue from sales of ion implantation products and related service was $326.0 million, or 95.1% of total revenue in 2019, compared with $421.7 million, or 95.3%, of total revenue in 2018.

Aftermarket

We refer to the business of selling spare parts, product upgrades, and used systems, combined with the sale of maintenance labor and service contracts and service hours, as the “aftermarket” business. Revenue from our aftermarket business was $140.4 million in 2019, compared to $162.2 million for 2018. Aftermarket revenue generally increases with the expansion of the installed base of systems but can fluctuate from period to period based on capacity utilization at customers’ manufacturing facilities which affects the sale of spare parts and demand for equipment service.

2018 Compared with 2017

Ion Implant

Revenue from sales of ion implantation products and related service was $421.7 million, or 95.3% of total revenue in 2018, compared with $391.1 million, or 95.2%, of total revenue in 2017.

Aftermarket

Revenue from our aftermarket business was $162.2 million in 2018, compared to $147.9 million for 2017.

Gross Profit / Gross Margin

The following table sets forth our gross profit:

	Year ended December 31,		Period-to-Period Change		Year ended December 31,		Period-to-Period Change	
	2019	2018	$	%	2018	2017	$	%
	(dollars in thousands)							
Gross Profit:								
Product	$ 143,773	$ 179,476	$ (35,703)	*(19.9)%*	$ 179,476	$ 152,192	$ 27,284	*17.9 %*
Product gross margin	*45.0 %*	*43.2 %*			*43.2 %*	*39.3 %*		
Services	379	160	219	*136.9 %*	160	(1,945)	2,105	*(108.2)%*
Services gross margin	*1.6 %*	*0.6 %*			*0.6 %*	*(8.3)%*		
Total gross profit	$ 144,152	$ 179,636	$ (35,484)	*(19.8)%*	$ 179,636	$ 150,247	$ 29,389	*19.6 %*
Gross margin	*42.0 %*	*40.6 %*			*40.6 %*	*36.6 %*		

2019 Compared with 2018

Product

Gross margin from product revenue was 45.0% for the twelve months ended December 31, 2019, compared to 43.2% for the twelve months ended December 31, 2018. The increase in gross margin of 1.8% resulted from improved margins on Purion systems.

Services

Gross margin from services revenue was 1.6% for the twelve months ended December 31, 2019, compared to 0.6% for the twelve months ended December 31, 2018. The increase in gross margin is attributable to changes in the mix of service contracts.

2018 Compared with 2017

Product

Gross margin from product revenue was 43.2% for the twelve months ended December 31, 2018, compared to 39.3% for the twelve months ended December 31, 2017. The increase in gross margin of 3.9% resulted from improved margins on Purion systems and a lower excess reserve for inventory due to a $6.2 million write-down of legacy inventory in 2017.

Services

Gross margin from services revenue was 0.6% for the twelve months ended December 31, 2018, compared to (8.3)% for the twelve months ended December 31, 2017. The increase in gross margin in the recent period is primarily attributable to decreased costs on service contracts.

Operating Expenses

The following table sets forth our operating expenses:

	Year ended December 31,		Period-to-Period Change		Year ended December 31,		Period-to-Period Change	
	2019	2018	$	%	2018	2017	$	%
	(dollars in thousands)							
Research and development	$ 53,931	$ 51,876	$ 2,055	*4.0 %*	$ 51,876	$ 43,071	$ 8,805	*20.4 %*
Percentage of revenue	*15.7 %*	*11.7 %*			*11.7 %*	*10.5 %*		
Sales and marketing	34,290	34,608	(318)	*(0.9)%*	34,608	28,532	6,076	*21.3 %*
Percentage of revenue	*10.0 %*	*7.8 %*			*7.8 %*	*6.9 %*		
General and administrative	31,726	33,193	(1,467)	*(4.4)%*	33,193	30,802	2,391	*7.8 %*
Percentage of revenue	*9.3 %*	*7.5 %*			*7.5 %*	*7.5 %*		
Total operating expenses	$ 119,947	$ 119,677	$ 270	*0.2 %*	$ 119,677	$ 102,405	$ 17,272	*16.9 %*
Percentage of revenue	*35.0 %*	*27.0 %*			*27.0 %*	*24.9% %*		

Our operating expenses consist primarily of personnel costs, including salaries, commissions, bonuses, stock-based compensation and related benefits and taxes; project material costs related to the design and development of new products and enhancement of existing products; and professional fees, travel and depreciation expenses. Personnel costs are our largest expense, representing $70.2 million, or 58.5% of our total operating expenses, for the year ended December 31, 2019; $74.3 million, or 62.1%, of our total operating expenses for the year ended December 31, 2018; and $64.5 million, or 63.0%, of our total operating expenses for the year ended December 31, 2017.

Research and Development

	Year ended December 31,		Period-to-Period Change		Year ended December 31,		Period-to-Period Change	
	2019	2018	$	%	2018	2017	$	%
	(dollars in thousands)							
Research and development	$ 53,931	$ 51,876	$ 2,055	*4.0 %*	$ 51,876	$ 43,071	8,805	*20.4 %*
Percentage of revenue	*15.7 %*	*11.7 %*			*11.7 %*	*10.5 %*		

Our ability to remain competitive depends largely on continuously developing innovative technology, with new and enhanced features and systems and introducing them at competitive prices on a timely basis. Accordingly, based on our strategic plan, we establish annual R&D budgets to fund programs that we expect will drive competitive advantages.

2019 Compared with 2018

Research and development expense was $53.9 million in 2019, an increase of $2.1 million, or 4.0%, compared with $51.9 million in 2018. The increase was primarily due to increased project costs to support development of new Purion products and extensions and increased depreciation associated with capital additions, partially offset by a reduction in variable incentive plan expense.

2018 Compared with 2017

Research and development expense was $51.9 million in 2018, an increase of $8.8 million, or 20.4%, compared with $43.1 million in 2017. The increase was primarily due to increased headcount and to project costs to support development of new Purion products and extensions.

Sales and Marketing

	Year ended December 31,		Period-to-Period Change		Year ended December 31,		Period-to-Period Change	
	2019	2018	$	%	2018	2017	$	%
	(dollars in thousands)							
Sales and marketing	$ 34,290	$ 34,608	$ (318)	*(0.9)*%	$ 34,608	$ 28,532	$ 6,076	*21.3 %*
Percentage of revenue	*10.0 %*	*7.8 %*			*7.8 %*	*6.9 %*		

Our sales and marketing expenses result primarily from the sale of our equipment and services through our direct sales force.

2019 Compared with 2018

Sales and marketing expense was $34.3 million in 2019, relatively flat when compared with $34.6 million in 2018.

2018 Compared with 2017

Sales and marketing expense was $34.6 million in 2018, an increase of $6.1 million, or 21.3%, compared with $28.5 million in 2017. The increase was primarily due to increased headcount.

General and Administrative

	Year ended December 31,		Period-to-Period Change		Year ended December 31,		Period-to-Period Change	
	2019	2018	$	%	2018	2017	$	%
	(dollars in thousands)							
General and administrative	$31,726	$33,193	$ (1,467)	*(4.4)*%	$33,193	$30,802	2,391	*7.8 %*
Percentage of revenue	*9.3 %*	*7.5 %*			*7.5 %*	*7.5 %*		

Our general and administrative expenses result primarily from the costs associated with our executive, finance, information technology, legal and human resource functions.

2019 Compared with 2018

General and administrative expense was $31.7 million in 2019, a decrease of $1.5 million, or 4.4% compared with $33.2 million in 2018. The decrease was primarily due to lower variable incentive plan expense.

2018 Compared with 2017

General and administrative expense was $33.2 million in 2018, an increase of $2.4 million, or 7.8% compared with $30.8 million in 2017. The increase was primarily due to increases in professional and consulting fees and to a lesser extent, increased headcount.

Other (Expense) Income

Other (expense) income consists primarily of interest expense relating to the lease obligation we incurred in connection with the 2015 sale of our headquarters facility (“sale leaseback”) and other financing obligations, foreign exchange gains and losses attributable to fluctuations of the U.S. dollar against the local currencies of certain of the countries in which we operate, as well as interest earned on our invested cash balances.

	Year ended December 31,		Period-to-Period Change		Year ended December 31,		Period-to-Period Change	
	2019	2018	$	%	2018	2017	$	%
	(dollars in thousands)							
Other expense	$ (3,283)	$ (5,254)	$ 1,971	*(37.5)%*	$ (5,254)	$ (4,011)	(1,243)	*31.0 %*
Percentage of revenue	*(1.0)%*	*(1.3)%*			*(1.3)%*	*(1.0)%*		

2019 Compared with 2018

Other expense for the year ended December 31, 2019 was $3.3 million, which includes $5.2 million of interest expense related to our sale leaseback obligation, $0.6 million of foreign currency translation losses and other miscellaneous expense of $0.5 million, partially offset by interest income of $3.0 million. Other expense for the year ended December 31, 2018 was $5.3 million, which includes $5.1 million of interest expense related to our sale leaseback obligation, $1.3 million of foreign currency translation losses and other miscellaneous expense of $1.2 million, partially offset by interest income of $2.3 million.

2018 Compared with 2017

Other expense for the year ended December 31, 2018 was $5.3 million, which includes $5.1 million of interest expense related to our sale leaseback obligation, $1.3 million of foreign currency translation losses and other miscellaneous expense of $1.2 million, partially offset by interest income of $2.3 million. Other expense for the year ended December 31, 2017 was $4.0 million, which includes $5.1 million of interest expense related to our sale leaseback obligation and other miscellaneous expense of $0.7 million, partially offset by interest income of $0.7 million and $1.1 million of foreign currency translation gains.

Income Taxes

	Year ended December 31,		Period-to-Period Change		Year ended December 31,		Period-to-Period Change	
	2019	2018	$	%	2018	2017	$	%
	(dollars in thousands)							
Income tax provision (benefit)	$ 3,888	$ 8,820	$ (4,932)	*(55.9)%*	$ 8,820	$ (83,128)	91,948	*(110.6)%*
Percentage of revenue	*1.1 %*	*1.9 %*			*1.9 %*	*(20.2)%*		

2019 Compared with 2018

Income tax expense was $3.9 million for the year ended December 31, 2019 compared to $8.8 million in the previous year. The income tax expense of $3.9 million in 2019 reflects a net effective tax rate of 18.6% on our worldwide pre-tax income. We have significant net operating loss carryforwards in the United States and certain European jurisdictions, and as a result, we do not currently pay significant income taxes in those jurisdictions.

At December 31, 2019, we had $68.1 million of net deferred tax assets worldwide relating to net operating loss carryforwards, tax credit carryforwards and other temporary differences, which are available to reduce income taxes in future years. We have continued to maintain an $8.3 million valuation allowance in the U.S. against certain tax credits and state net operating losses due to the uncertainty of their realization based on long-term Company forecasts and the expiration dates on these attributes. If future operating results of the U.S. or these foreign jurisdictions are significantly less than our expectations, it is reasonably possible that we would be required to record an additional valuation allowance on our deferred tax assets in the future.

2018 Compared with 2017

Income tax expense was $8.8 million for the year ended December 31, 2018 compared to an income tax benefit of $83.1 million in the previous year. The income tax expense of $8.8 million in 2018 reflects a net effective tax rate of 16.1% on our worldwide pre-tax income. The income tax benefit of $83.1 million in 2017 was primarily due to the release of our valuation allowance on our deferred tax assets.

Liquidity and Capital Resources

Our liquidity is affected by many factors. Some of these relate specifically to the operations of our business. For example, our sales and other factors are influenced by the uncertainties of global economies, including the availability of credit and the condition of the overall semiconductor capital equipment industry. Our established cost structure does not vary significantly with changes in volume. We experience fluctuations in operating results and cash flows depending on fluctuations in our revenue level.

In 2019, $13.6 million of cash was used in operating activities. This compares to $47.0 million of cash provided by operations in 2018. Cash and cash equivalents at December 31, 2019 was $139.9 million, compared to $178.0 million at December 31, 2018. Approximately $20.9 million of cash was located in foreign jurisdictions as of December 31, 2019. In addition to the cash and cash equivalent balance at December 31, 2019, we had $6.7 million in restricted cash which relates to a $5.9 million letter of credit associated with the security deposit for the lease on our corporate headquarters in Beverly, Massachusetts, a $0.7 million letter of credit relating to workers' compensation insurance and a $0.1 million deposit relating to customs activity. Working capital at December 31, 2019 was $307.0 million. At December 31, 2019, we had no bank debt.

Capital expenditures were $12.0 million and $4.7 million for the years ended December 31, 2019 and 2018, respectively. Total capital expenditures for 2020 are projected to be approximately $7.5 million. Future capital expenditures beyond 2020 will depend on a number of factors, including the timing and rate of expansion of our business and our ability to generate cash to fund them.

Cash used in financing activities for the year ended December 31, 2019 was $13.4 million, which consisted of $17.7 million related to our stock repurchase program, $1.6 million related to net settlement of restricted stock issuances, partially offset by $5.1 million in proceeds of stock option exercises and $0.9 million in proceeds from our employee stock purchase plan. Cash provided by financing activities was $1.2 million for the year ended December 31, 2018, mainly due to the exercise of stock options and proceeds received from the employee stock purchase plan.

We have outstanding letters of credit and surety bonds in the amount of $10.6 million to cover the security deposit under the lease of our headquarters, workers' compensation insurance program, customs and bank deposits and certain value added tax claims in Europe.

On December 3, 2019, we announced that our Board of Directors authorized an increase and extension of the share repurchase program, of up to $50 million of the Company's common stock through 2020. These shares may be purchased in the open market or through privately negotiated transactions. We have no obligation to repurchase shares under the authorization, and the timing and actual number and value of shares which are repurchased will depend on a number of factors, including the price of the Company's common stock, general business and market conditions, and alternative investment opportunities. We may suspend or discontinue the repurchase program at any time.

The following represents our commercial commitments as of December 31, 2019 (in thousands):

Other Commercial Commitments	Total	Amount of Commitment Expiration by Period		
		2020	2021	2022
Surety bonds	$ 3,937	$ 1,087	$ 2,554	$ 296
Standby letters of credit and deposits	6,642	6,642	—	—
Total	$ 10,579	$ 7,729	$ 2,554	$ 296

The following represents our contractual obligations as of December 31, 2019 (in thousands):

Contractual Obligations	Total	Payments Due by Period			
		2020	2021-2022	2023-2024	2025 - Beyond
Sale leaseback obligation	$ 109,567	$ 5,720	$ 11,828	$ 12,366	$ 79,653
Purchase order commitments	62,436	61,454	909	3	70
Operating leases	6,388	3,511	2,475	196	206
Total	$ 178,391	$ 70,685	$ 15,212	$ 12,565	$ 79,929

We have no off-balance sheet arrangements at December 31, 2019.

We have net operating loss and tax credit carryforwards, the tax effect of which aggregate $66.0 million at December 31, 2019. These carryforwards, which expire principally between 2020 and 2039, are available to reduce future income tax liabilities in the United States and certain foreign jurisdictions.

We consider the undistributed earnings of our foreign subsidiaries as of December 31, 2019, to be indefinitely reinvested and, accordingly, no U.S. income taxes have been provided thereon. As of December 31, 2019, the amount of cash associated with indefinitely reinvested foreign earnings was approximately $9.7 million. We have not, nor do we anticipate the need to, repatriate funds to the United States to satisfy domestic liquidity needs arising in the ordinary course of business, including liquidity needs associated with our domestic debt service requirements. Upon repatriation of those earnings, in the form of dividends or otherwise, we could be subject to withholding taxes payable to the various foreign tax jurisdictions.

We believe that based on our current market, revenue, expense and cash flow forecasts, our existing cash, cash equivalents and borrowing capacity will be sufficient to satisfy our anticipated cash requirements for the short and long-term. We currently have no credit facility but management believes we would be able to borrow on reasonable terms if needed.

Related-Party Transactions

There are no significant related-party transactions that require disclosure in the consolidated financial statements for the year ended December 31, 2019, or in this Annual Report on Form 10-K.

Recent Accounting Pronouncements

A discussion of recent accounting pronouncements, the impact of some of which may be material, is included in Note 2 to the consolidated financial statements for the year ended December 31, 2019 included in this Annual Report on Form 10-K.

Item 7A. Quantitative and Qualitative Disclosures about Market Risk.

Interest Rate Sensitivity

Our exposure to market risk for changes in interest rates relates primarily to our investment portfolio, which consists entirely of cash equivalents at December 31, 2019. The primary objective of our investment activities is to preserve principal. This is accomplished by investing in marketable investment grade securities. We do not use derivative financial instruments in managing our investment portfolio. Due to the nature of our investments, we do not expect our operating results or cash flows to be affected to any significant degree by any change in market interest rates.

Foreign Currency Exchange Risk

Substantially all of our sales are billed in U.S. dollars, thereby reducing the impact of fluctuations in foreign exchange rates on our results. Operating margins of certain foreign operations can fluctuate with changes in foreign exchange rates to the extent revenue is billed in U.S. dollars and operating expenses are incurred in the local currency. During the years ended December 31, 2019 and 2018, approximately 25.3% and 22.5% of our revenue were derived in local currencies from foreign operations with this inherent risk. In addition, at both December 31, 2019 and 2018, our operations outside of the United States accounted for approximately 13.4% and 12.9% of our total assets, respectively, the majority of which was denominated in currencies other than the U.S. dollar. We currently do not use derivative financial instruments in managing our foreign currency exchange risk.

Item 8. Financial Statements and Supplementary Data.

Response to this Item is submitted as a separate section of this report immediately following Item 15.

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 principal executive officer and principal financial officer, has evaluated the effectiveness of our disclosure controls and procedures (as defined in Rule 13a-15(e) under the Securities Exchange Act of 1934, as amended (the “Exchange Act”) as of the end of the period covered by this annual report (the “Evaluation Date”). Based on this evaluation, our principal executive officer and principal financial officer concluded that, as of the Evaluation Date, these disclosure controls and procedures are effective.

Internal Control over Financial Reporting

Management’s Annual Report on Internal Control over Financial Reporting

Management is responsible for establishing and maintaining adequate internal control over financial reporting, as such term is defined in Rule 13a-15(f) under the Exchange Act. Because of its inherent limitations, internal control over financial reporting may not prevent or detect all misstatements. A control system, no matter how well designed and operated, can provide only reasonable assurance with respect to financial statement preparation and presentation. 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 assessed the effectiveness of our internal control over financial reporting as of December 31, 2019. In making this assessment, management used the criteria set forth in the Committee of Sponsoring Organizations of the Treadway Commission (COSO) Internal Control—2013 Integrated Framework.

Based on this assessment, management has concluded that, as of December 31, 2019, our internal control over financial reporting is effective based on those criteria.

The independent registered public accounting firm of Ernst & Young LLP, as auditors of our consolidated financial statements, has issued an attestation report on its assessment of our internal control over financial reporting.

Report of Independent Registered Public Accounting Firm

To the Stockholders and the Board of Directors of Axcelis Technologies, Inc

Opinion on Internal Control Over Financial Reporting

We have audited Axcelis Technologies, Inc.'s internal control over financial reporting as of December 31, 2019, based on criteria established in Internal Control—Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission (2013 framework) (the COSO criteria). In our opinion, Axcelis Technologies, Inc. (the Company) maintained, in all material respects, effective internal control over financial reporting as of December 31, 2019, based on the COSO criteria.

We also have audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States) (PCAOB), the 2019 consolidated financial statements of the Company and our report dated March 2, 2020 expressed an unqualified opinion thereon.

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 Annual 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 included obtaining an understanding of internal control over financial reporting, assessing the risk that a material weakness exists, testing and evaluating the design and operating effectiveness of internal control based on the assessed risk, and 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/ Ernst & Young LLP

Boston, Massachusetts
March 2, 2020

Changes in Internal Control over Financial Reporting

There was no change in our internal control over financial reporting (as defined in Rule 13a-15(f) under the Exchange Act) identified in connection with the evaluation of our internal control that occurred during our fourth quarter that has materially affected, or is reasonably likely to materially affect, our internal control over financial reporting.

PART III

Item 10. Directors, Executive Officers and Corporate Governance.

A portion of the information required by Item 10 of Form 10-K is incorporated by reference from the information responsive thereto contained in the sections in Axcelis Proxy Statement for the Annual Meeting of Stockholders to be held May 19, 2020 (the "Proxy Statement") captioned:

- "Proposal 1: Election of Directors,"
- "Board of Directors,"
- "Board Committees," and
- "Corporate Governance,"

The remainder of such information is set forth under the heading "Information about our Executive Officers" at the end of Item 1 in Part I of this report and is incorporated herein by reference.

Item 11. Executive Compensation.

The information required by Item 11 of Form 10-K is incorporated by reference from the information responsive thereto contained in the sections in the Proxy Statement captioned:

- "Executive Compensation," and
- "Board Committees—Compensation Committee Interlocks and Insider Participation."

Item 12. Security Ownership of Certain Beneficial Owners and Management and Related Stockholder Matters.

The information required by Item 12 of Form 10-K is incorporated by reference from the information responsive thereto contained in the sections in the Proxy Statement captioned:

- "Share Ownership of 5% Stockholders," and
- "Share Ownership of Directors and Executive Officers,"

Item 13. Certain Relationships and Related Transactions and Director Independence.

The information required by Item 13 of Form 10-K is incorporated by reference from the information responsive thereto contained in the sections in the Proxy Statement captioned:

- "Executive Compensation,"
- "Board of Directors," and
- "Corporate Governance—Certain Relationships and Related Transactions."

Item 14. Principal Accounting Fees and Services

The information required by Item 14 of Form 10-K is incorporated by reference from the information responsive thereto contained in the section captioned "Proposal 3: Ratification of the Appointment of our Independent Registered Public Accounting Firm" in the Proxy Statement.

PART IV

Item 15. Exhibits, Financial Statement Schedules.

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

1) Financial Statements:

2) Financial Statement Schedules:

Schedule II—Valuation and Qualifying Accounts for the years ended December 31, 2019, 2018 and 2017.

3) Exhibits

The exhibits filed as part of this Form 10-K are listed on the Exhibit Index immediately preceding the signature page, which Exhibit Index is incorporated herein by reference.

All other schedules for which provision is made in the applicable regulation of the Securities and Exchange Commission are not required under the related instructions or are inapplicable, and therefore have been omitted.

Item 16. Form 10-K Summary

Not applicable.

Report of Independent Registered Public Accounting Firm

To the Stockholders and the Board of Directors of Axcelis Technologies, Inc.

Opinion on the Financial Statements

We have audited the accompanying consolidated balance sheets of Axcelis Technologies, Inc. (the Company) as of December 31, 2019 and 2018, the related consolidated statements of operations, comprehensive income, stockholders' equity and cash flows for each of the three years in the period ended December 31, 2019, and the related notes and financial statement schedule listed in the Index at Item 15(a) (collectively referred to as the "consolidated financial statements"). In our opinion, the consolidated financial statements present fairly, in all material respects, the financial position of the Company at December 31, 2019 and 2018, and the results of its operations and its cash flows for each of the three years in the period ended December 31, 2019, 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, 2019, based on criteria established in Internal Control—Integrated Framework issued by the Committee of Sponsoring Organizations of the Treadway Commission (2013 framework), and our report dated March 2, 2020 expressed an unqualified opinion thereon.

Adoption of New Accounting Standards

As discussed in Note 2 to the consolidated financial statements, the Company changed its method for accounting for leases in 2019. As discussed in Note 2 to the consolidated financial statements, the Company changed its method for accounting for revenue in 2018.

Basis for Opinion

These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on the Company's 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 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 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 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 financial statements. We believe that our audits provide a reasonable basis for our opinion.

/s/ Ernst & Young LLP

We have served as the Company's auditor since 1999.

Boston, Massachusetts
March 2, 2020

Axcelis Technologies, Inc.
Consolidated Statements of Operations
(In thousands, except per share amounts)

	Twelve months ended December 31,		
	2019	2018	2017
Revenue:			
Product	$ 319,505	$ 415,922	$ 387,124
Services	23,453	26,653	23,437
Total revenue	342,958	442,575	410,561
Cost of revenue:			
Product	175,732	236,446	234,932
Services	23,074	26,493	25,382
Total cost of revenue	198,806	262,939	260,314
Gross profit	144,152	179,636	150,247
Operating expenses:			
Research and development	53,931	51,876	43,071
Sales and marketing	34,290	34,608	28,532
General and administrative	31,726	33,193	30,802
Total operating expenses	119,947	119,677	102,405
Income from operations	24,205	59,959	47,842
Other (expense) income:			
Interest income	2,955	2,328	714
Interest expense	(5,155)	(5,110)	(5,121)
Other, net	(1,083)	(2,472)	396
Total other expense	(3,283)	(5,254)	(4,011)
Income before income taxes	20,922	54,705	43,831
Income tax provision (benefit)	3,888	8,820	(83,128)
Net income	$ 17,034	$ 45,885	$ 126,959
Net income per share:			
Basic	$ 0.52	$ 1.42	$ 4.11
Diluted	$ 0.50	$ 1.35	$ 3.80
Shares used in computing net income per share:			
Basic weighted average common shares	32,559	32,286	30,866
Diluted weighted average common shares	33,828	34,002	33,436

See accompanying Notes to these Consolidated Financial Statements

Axcelis Technologies, Inc.
Consolidated Statements of Comprehensive Income
(In thousands)

	Twelve months ended December 31,		
	2019	**2018**	**2017**
Net income	$ 17,034	$ 45,885	$ 126,959
Other comprehensive (loss) income:			
Foreign currency translation adjustments	(444)	(1,794)	4,347
Amortization of actuarial loss and other adjustments from pension plan	(262)	66	108
Total other comprehensive (loss) income	(706)	(1,728)	4,455
Comprehensive income	$ 16,328	$ 44,157	$ 131,414

See accompanying Notes to these Consolidated Financial Statements

Axcelis Technologies, Inc.
Consolidated Balance Sheets
(In thousands, except per share amounts)

	December 31, 2019	December 31, 2018
ASSETS		
Current assets:		
Cash and cash equivalents	$ 139,881	$ 177,993
Accounts receivable, net	83,753	78,727
Inventories, net	140,364	129,000
Prepaid expenses and other current assets	11,681	11,051
Total current assets	375,679	396,771
Property, plant and equipment, net	25,328	41,149
Operating lease assets	5,849	—
Finance lease assets, net	21,880	—
Long-term restricted cash	6,653	6,909
Deferred income taxes	68,060	71,939
Other assets	44,645	31,673
Total assets	$ 548,094	$ 548,441
LIABILITIES AND STOCKHOLDERS' EQUITY		
Current liabilities:		
Accounts payable	$ 25,341	$ 35,955
Accrued compensation	7,631	19,218
Warranty	2,759	4,819
Income taxes	294	462
Deferred revenue	24,601	19,513
Current portion of finance lease obligation	399	—
Other current liabilities	7,639	5,030
Total current liabilities	68,664	84,997
Finance lease obligation	48,149	47,757
Long-term deferred revenue	4,650	3,071
Other long-term liabilities	7,204	4,279
Total liabilities	128,667	140,104
Commitments and contingencies (Note 16)		
Stockholders' equity:		
Common stock, $0.001 par value, 75,000 shares authorized; 32,585 shares issued and outstanding at December 31, 2019; 32,558 shares issued and outstanding at December 31, 2018	33	33
Additional paid-in capital	559,878	565,116
Accumulated deficit	(140,226)	(157,260)
Accumulated other comprehensive (loss) income	(258)	448
Total stockholders' equity	419,427	408,337
Total liabilities and stockholders' equity	$ 548,094	$ 548,441

See accompanying Notes to these Consolidated Financial Statements

Axcelis Technologies, Inc.
Consolidated Statements of Stockholders' Equity
(In thousands)

	Common Stock Shares	Common Stock Amount	Additional Paid-in Capital	Accumulated Deficit	Accumulated Other Comprehensive Income (Loss)	Total Stockholders' Equity
Balance at December 31, 2016	29,518	$ 30	$ 535,408	$ (331,704)	$ (2,279)	$ 201,455
Net income	—	—	—	126,959	—	126,959
Foreign currency translation adjustments	—	—	—	—	4,347	4,347
Change in pension obligation	—	—	—	—	108	108
Exercise of stock options	2,358	2	15,512	—	—	15,514
Issuance of shares under Employee Stock Purchase Plan	34	—	845	—	—	845
Issuance of restricted common shares	138	—	(1,164)	—	—	(1,164)
Stock-based compensation expense	—	—	5,546	—	—	5,546
Balance at December 31, 2017	32,048	32	556,147	(204,745)	2,176	353,610
Net income	—	—	—	45,885	—	45,885
Foreign currency translation adjustments	—	—	—	—	(1,794)	(1,794)
Change in pension obligation	—	—	—	—	66	66
Exercise of stock options	273	1	1,733	—	—	1,734
Issuance of shares under Employee Stock Purchase Plan	55	—	1,025	—	—	1,025
Issuance of restricted common shares	182	—	(1,419)	—	—	(1,419)
Adjustment to Retained Earnings upon ASC 606 Adoption	—	—	—	1,600	—	1,600
Stock-based compensation expense	—	—	7,630	—	—	7,630
Balance at December 31, 2018	32,558	33	565,116	(157,260)	448	408,337
Net income	—	—	—	17,034	—	17,034
Foreign currency translation adjustments	—	—	—	—	(444)	(444)
Change in pension obligation	—	—	—	—	(262)	(262)
Exercise of stock options	775	1	5,104	—	—	5,105
Issuance of shares under Employee Stock Purchase Plan	54	—	1,016	—	—	1,016
Issuance of restricted common shares	250	—	(1,633)	—	—	(1,633)
Stock-based compensation expense	—	—	8,018	—	—	8,018
Repurchase of common stock	(1,052)	(1)	(17,743)	—	—	(17,744)
Balance at December 31, 2019	32,585	$ 33	$ 559,878	$ (140,226)	$ (258)	$ 419,427

See accompanying Notes to these Consolidated Financial Statements

Axcelis Technologies, Inc.
Consolidated Statements of Cash Flows
(In thousands)

	Twelve months ended December 31,		
	2019	2018	2017
Cash flows from operating activities			
Net income	$ 17,034	$ 45,885	$ 126,959
Adjustments to reconcile net income to net cash (used in) provided by operating activities:			
Depreciation and amortization	7,880	5,772	5,002
Deferred income taxes	3,304	11,209	(82,085)
Stock-based compensation expense	8,173	7,784	5,672
Provision for doubtful accounts	818	—	—
Provision for excess and obsolete inventory	2,794	2,205	8,135
Changes in operating assets & liabilities:			
Accounts receivable	(6,002)	(3,877)	(23,573)
Inventories	(17,953)	(10,512)	(10,567)
Prepaid expenses and other current assets	(104)	(1,436)	(3,866)
Accounts payable and other current liabilities	(19,150)	(703)	25,000
Deferred revenue	6,672	6,055	7,079
Income taxes	(162)	196	14
Other assets and liabilities	(16,898)	(15,613)	(1,486)
Net cash (used in) provided by operating activities	(13,594)	46,965	56,284
Cash flows from investing activities			
Expenditures for property, plant and equipment and capitalized software	(11,969)	(4,715)	(7,285)
Net cash used in investing activities	(11,969)	(4,715)	(7,285)
Cash flows from financing activities			
Net settlement on restricted stock grants	(1,632)	(1,419)	(1,184)
Repurchase of common stock	(17,744)	—	—
Proceeds from Employee Stock Purchase Plan	863	871	739
Proceeds from exercise of stock options	5,105	1,734	15,515
Net cash (used in) provided by financing activities	(13,408)	1,186	15,070
Effect of exchange rate changes on cash and cash equivalents	603	586	(844)
Net (decrease) increase in cash, cash equivalents and restricted cash	(38,368)	44,022	63,225
Cash, cash equivalents and restricted cash at beginning of period	184,902	140,880	77,655
Cash, cash equivalents and restricted cash at end of period	$ 146,534	$ 184,902	$ 140,880
Supplemental disclosure of cash flow information			
Cash paid for:			
Income taxes	$ 1,028	$ 858	$ 583
Interest	$ 5,207	$ 5,470	$ 5,315

See accompanying Notes to these Consolidated Financial Statements

Note 1. Nature of Business

Axcelis Technologies, Inc. (“Axcelis” or the “Company”) was incorporated in Delaware in 1995, and is a worldwide producer of ion implantation and other processing equipment used in the fabrication of semiconductor chips in the United States, Europe and Asia. In addition, we provide extensive aftermarket service and support, including spare parts, equipment upgrades, used equipment and maintenance services to the semiconductor industry.

Note 2. Summary of Significant Accounting Policies

The accompanying consolidated financial statements reflect the application of certain significant accounting policies as described in this note and elsewhere in the footnotes.

(a) Basis of Presentation

The accompanying consolidated financial statements include the consolidated accounts of the Company and its wholly-owned, controlled subsidiaries. All intercompany balances and transactions have been eliminated in consolidation.

Events occurring subsequent to December 31, 2019 have been evaluated for potential recognition or disclosure in the consolidated financial statements.

(b) Use of Estimates

The preparation of these consolidated financial statements in conformity with accounting principles generally accepted in the United States of America requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and the disclosure of contingent assets and liabilities at the dates of the financial statements and the reported amounts of revenue and expenses during the reporting periods. On an ongoing basis, we evaluate our estimates and judgments, including those related to revenue recognition, the realizable value of accounts receivable and inventories, valuing stock-based compensation instruments and reserves relating to tax assets and liabilities. Actual amounts could differ from these estimates. Changes in estimates are recorded in the period in which they become known.

(c) Foreign Currency

The functional currency for substantially all operations outside the United States is the local currency. Financial statements for these operations are translated into United States dollars at year-end rates as to assets and liabilities and average exchange rates during the year as to revenue and expenses. The resulting translation adjustments are recorded in stockholders’ equity as an element of accumulated other comprehensive income (loss). Foreign currency transaction gains and losses are included in other income (expense) in the Consolidated Statements of Operations.

For the year ended December 31, 2019 we had $0.6 million in foreign exchange loss. For the year ended December 31, 2018 we had $1.3 million in foreign exchange loss. For the year ended December 31, 2017 we had $1.1 million in foreign exchange gains.

(d) Cash and Cash Equivalents

Cash and cash equivalents consist of cash on hand and highly liquid investments with original maturities of ninety days or less. Cash equivalents consist primarily of money market funds, U.S. Government and Agency Securities and deposit accounts. Cash equivalents are carried on the balance sheet at fair market value.

(e) Inventories

Inventories are carried at the lower of cost or net realizable value, determined using the first-in, first-out ("FIFO") method, or market. We periodically review our inventories and make provisions as necessary for estimated obsolescence or damaged goods to ensure values approximate lower of cost or net realizable value. The amount of such markdowns is equal to the difference between cost of inventory and the estimated market value based upon assumptions about future demands, selling prices, and market conditions.

We record a provision for estimated excess inventory. The provision is determined using management's assumptions of materials usage, based on estimates of demand and market conditions. If actual market conditions become less favorable than those projected by management, additional inventory write-downs may be required.

(f) Property, Plant and Equipment and Leased Assets

Property, plant and equipment are stated at cost, less accumulated depreciation and amortization.

On January 30, 2015, we sold our corporate headquarters facility. As part of this sale, we also entered into a 22-year lease agreement. We accounted for the sale leaseback transaction as a financing arrangement for financial reporting purposes. We retained the historical costs of the property and the related accumulated depreciation on our financial books within property, plant and equipment and will continue to depreciate the property for financial reporting purposes over the lesser of its remaining useful life or its initial lease term of 22 years.

On January 1, 2019, we adopted Accounting Standard Update ("ASU") No. 2016-02 *"Leases."* This update requires operating lease assets and finance lease assets be classified separately from owned assets on the balance sheet. See Note 9 for further discussion.

Depreciation and amortization are recorded using the straight-line method over the estimated useful lives of the related assets as follows:

Asset Classification	Estimated Useful Life
Land, buildings and equipment (under lease)	Lesser of the lease term or estimated useful life of the asset
Machinery and equipment	3 to 10 years

Repairs and maintenance costs are expensed as incurred. Expenditures for renewals and betterments are capitalized.

(g) Impairment of Long-Lived Assets

We record impairment losses on long-lived assets when events and circumstances indicate that these assets might not be recoverable. Recoverability is measured by a comparison of the assets' carrying amount to their expected future undiscounted net cash flows. If such assets are considered to be impaired, the impairment is measured based on the amount by which the carrying value exceeds its fair value.

We did not have any indicators of impairment during the period ending December 31, 2019. We did not record an impairment charge in the years ended December 31, 2019, 2018, or 2017.

Actual performance could be materially different from our current forecasts, which could impact estimates of undiscounted cash flows and may result in the impairment of the carrying amount of the long-lived assets in the future. This could be caused by strategic decisions made in response to economic and competitive conditions, the impact of the economic environment on our customer base, or a material adverse change in our relationships with significant customers.

(h) Concentration of Risk and Off-Balance Sheet Risk

Financial instruments that potentially subject us to concentrations of credit risk are principally cash equivalents and accounts receivable. Our cash equivalents are principally maintained in investment grade money-market funds, U.S. Government and Agency Securities and deposit accounts.

We have no significant off-balance-sheet risk such as currency exchange contracts, option contracts or other hedging arrangements.

Our exposure to market risk for changes in interest rates relates primarily to cash equivalents. The primary objective of our investment activities is to preserve principal without significantly increasing risk. This is accomplished by investing in marketable investment grade securities. We do not use derivative financial instruments to manage our investment portfolio and do not expect operating results or cash flows to be affected to any significant degree by any change in market interest rates.

We perform ongoing credit evaluations of our customers' financial condition and generally require no collateral to secure accounts receivable. For selected overseas sales, we require customers to obtain letters of credit before product is shipped. We maintain an allowance for doubtful accounts based on our assessment of the collectability of accounts receivable. We review the allowance for doubtful accounts quarterly. We do not have any off-balance sheet credit exposure related to our customers.

Our customers consist of semiconductor chip manufacturers located throughout the world and net sales to our ten largest customers accounted for 74.1%, 76.9% and 73.3% of revenue in 2019, 2018 and 2017, respectively.

For the year ended December 31, 2019, we had three customers representing 18.2%, 14.2% and 12.0% of total revenue, respectively. For the year ended December 31, 2018, we had two customers representing 20.1% and 12.1% of total revenue, respectively. For the year ended December 31, 2017 we had two customers representing 24.9% and 13.1% of total revenue, respectively.

As of December 31, 2019, we had three customers account for 24.9%, 15.3% and 11.1% of consolidated accounts receivable, respectively. As of December 31, 2018, we had two customers account for 21.9% and 11.5% of consolidated accounts receivable, respectively.

Some of the components and sub-assemblies included in our products are obtained either from a sole source or a limited group of suppliers. Disruption to our supply source, resulting either from economic conditions or other factors, could affect our ability to deliver products to our customers.

(i) Revenue Recognition

Effective January 1, 2018, we adopted Financial Accounting Standards Board ("FASB") Accounting Standards Codification ("ASC") Topic 606, *Revenue from Contracts with Customers* or ("ASC 606"). In accordance with ASC 606, we changed certain characteristics of our revenue recognition accounting policy as described below. On adoption, ASC 606 was applied only to open contracts using the modified retrospective method, where the cumulative effect of the initial application is recognized as an adjustment to opening retained earnings at January 1, 2018. Therefore, the year ended December 31, 2017 has not been adjusted and continues to be reported under FASB ASC Topic 605, *Revenue Recognition*, or ASC 605.

Under ASC 606, revenue is recognized when a customer obtains control of promised goods or services in an amount that reflects the consideration we expect to receive in exchange for those goods or services. We measure revenue based on the consideration specified in the customer arrangement, and revenue is recognized when the performance obligations in the customer arrangement are satisfied. A performance obligation is a promise in a contract to transfer a distinct product or service to the customer. The transaction price of a contract is allocated to each distinct performance obligation based upon the relative standalone selling price for each performance obligation and recognized as revenue when, or as, the customer receives the benefit of the performance obligation. To account for and measure revenue, we apply the following five steps:

1) *Identify the contract with the customer*

A contract with a customer exists when (i) we enter into an enforceable contract with a customer that defines each party’s rights regarding the goods or services to be transferred and identifies the related payment terms, (ii) the contract has commercial substance, and (iii) we determine that collection of substantially all consideration for goods and services that are transferred is probable based on the customer’s intent and ability to pay the promised consideration.

2) *Identify the performance obligations in the contract*

Performance obligations promised in a contract are identified based on the goods and services that will be transferred to the customer that are both capable of being distinct, whereby the customer can benefit from the good or service either on its own or together with other available resources, and are distinct in the context of the contract, whereby the transfer of the good or service is separately identifiable from other promises in the contract. To the extent a contract includes multiple promised goods and services, we must apply judgment to determine whether promised goods and services are capable of being distinct and distinct in the context of the contract. If these criteria are not met, the promised goods and services are accounted for as a combined performance obligation.

Systems sales consist of multiple performance obligations, including the system itself and obligations that are not delivered simultaneously with the system. These undelivered obligations might include a combination of installation services, extended warranty and support and spare parts, all of which are generally covered by a single sales price.

The aftermarket business includes both products and services type arrangements. Performance obligations in these contracts consist of used tools, spare parts, equipment upgrades, maintenance services and customer training.

Customers who purchase new systems are provided an assurance-type warranty for one year after acceptance of the tool. For aftermarket transactions, we provide customers an assurance-type warranty for 90 days. Customers can choose to purchase extended warranty terms with enhanced support similar to a service-type warranty ranging from one to three years. In accordance with ASC 606, assurance-type warranties are not considered a performance obligation, whereas service-type warranties are.

3) *Determine the transaction price*

The transaction price is determined based on the consideration to which we will be entitled in exchange for transferring goods and services to the customer. To the extent the transaction price includes variable consideration, we estimate the amount of variable consideration that should be included in the transaction price utilizing either the expected value method or the most likely amount method depending on the nature of the variable consideration. Variable consideration is included in the transaction price if, in our judgment, it is probable that a significant future reversal of cumulative revenue under the contract will not occur. Any estimates, including the effect of the constraint on variable consideration, are evaluated at each reporting period for any changes. In applying this guidance, Companies must also consider whether any significant financing components exist.

The transaction price for all transactions is based on the price reflected in the individual customer’s purchase order. Variable consideration has not been identified as a significant component of the transaction price for any of our transactions.

For those transactions where all performance obligations will be satisfied within one year or less, we apply the practical expedient outlined in ASC 606-10-32-18. This practical expedient allows us not to adjust promised consideration for the effects of a significant financing component if we expect at contract inception that the period between when we transfer the promised good or service to a customer and when the customer pays for that good or service will be one year or less. For those transactions that are expected to be completed after one year, we have assessed that there are no significant financing components because any difference between the promised consideration and the cash selling price of the good or service is for reasons other than the provision of financing.

4) *Allocate the transaction price to performance obligations in the contract*

If the contract contains a single performance obligation, the entire transaction price is allocated to the single performance obligation. Contracts that contain multiple performance obligations require an allocation of the transaction price to each performance obligation on a relative standalone selling price basis unless the transaction price is variable and meets the criteria to be allocated entirely to a performance obligation or to a distinct service that forms part of a single performance obligation.

Where required, we determine standalone selling price (SSP) for each obligation based on consideration of both market and Company specific factors, including the selling price and profit margin for similar products, the cost to produce, and the anticipated margin.

For those contracts that contain multiple performance obligations (primarily systems sales, as well as some aftermarket contracts requiring both time and material inputs), we must determine the SSP. We use a cost plus margin approach in determining the SSP for any materials related performance obligations (such as upgrades, spare parts, systems). To determine the SSP for labor related performance obligations (such as the labor component of installation), we use directly observable inputs based on the standalone sale prices for these services.

5) *Recognize revenue when or as we have satisfied a performance obligation*

We satisfy performance obligations either over time or at a point in time. Revenue is recognized over time if either 1) the customer simultaneously receives and consumes the benefits provided by the entity’s performance, 2) the entity’s performance creates or enhances an asset that the customer controls as the asset is created or enhanced, or 3) the entity’s performance does not create an asset with an alternative use to the entity and the entity has an enforceable right to payment for performance completed to date. If the entity does not satisfy a performance obligation over time, the related performance obligation is satisfied at a point in time by transferring the control of a promised good or service to a customer. Examples of control are using the asset to produce goods or services, enhance the value of other assets or settle liabilities, and holding or selling the asset. For over time recognition, ASC 606 requires us to select a single revenue recognition method for the performance obligation that faithfully depicts our performance in transferring control of the goods and services. The guidance allows entities to choose between two methods to measure progress toward complete satisfaction of a performance obligation:

Output methods - recognize revenue on the basis of direct measurements of the value to the customer of the goods or services transferred to date relative to the remaining goods or services promised under the contract (e.g. surveys of performance completed to date, appraisals of results achieved, milestones reached, time elapsed, and units produced or units delivered); and

Input methods - recognize revenue on the basis of the entity’s efforts or inputs to the satisfaction of a performance obligation (e.g., resources consumed, labor hours expended, costs incurred, or time elapsed) relative to the total expected inputs to the satisfaction of that performance obligation.

We have the right to consideration from a customer in an amount that corresponds directly with the value to the customer of the entity’s performance completed to date (i.e., certain aftermarket contracts), as such we have elected a practical expedient to recognize revenue in the amount to which the entity has a right to invoice for such services.

Product related revenues (whether for systems or aftermarket business) are recognized at a point in time, when they are shipped or delivered, depending on shipping terms.

For installation services, revenue is recognized at a point in time, once the installation of the tool is complete. The nature of the installation services is such that the customer does not simultaneously receive and consume the benefits provided by the entity’s performance, nor does performance of installation services create or enhance an asset that the customer controls. Installation services do not create an asset with an alternative use to the entity, and the entity does not have an enforceable right to payment for performance completed to date.

Contract liabilities are reflected as deferred revenue on the consolidated balance sheet. Contract liabilities relate to payments invoiced or received in advance of completion of performance obligations under a contract. Contract liabilities are recognized as revenue upon the fulfillment of performance obligations.

Service-type warranties for any product are recognized over time, as these represent a stand ready obligation to service the product during the warranty period. Progress in the satisfaction of these performance obligations will be measured using an input method of time elapsed.

Maintenance and service contracts are recognized over time. Progress in the satisfaction of these performance obligations will be measured using an input method of either time elapsed in the case of fixed period contracts, or labor hours expended, in the case of project-based contracts.

(j) Recognizing Assets related to Recoverable Customer Contract Costs

We recognize an asset related to incremental costs incurred by us to obtain a contract with a customer if we expect to recover those costs. We will recognize an asset from costs incurred to fulfill a contract only if such costs relate directly to a contract with an entity that we can specifically identify, the costs incurred will generate or enhance resources that will be used in satisfying performance obligations in the future, and the costs are expected to be recovered. Any assets recognized related to costs to obtain or fulfill a contract are amortized on a systematic basis that is consistent with the transfer to the customer of the goods or services to which the asset relates.

In substantially all of our business transactions, we incur incremental costs to obtain contracts with customers, in the form of sales commissions. We maintain a commission program which awards our employees for System sales, aftermarket activity and other individual goals. Under ASC 606, an asset is amortized on a systematic basis that is consistent with the transfer to the customer of the goods or services to which the asset relates. However, ASC 606 provides a practical expedient to allow for the recognition of commission expense when incurred if the amortization period of the asset that the entity otherwise would have recognized is one year or less. Based on the nature of our commission agreements, all commissions are expensed as incurred based upon the expectation that the amortization period would be one year or less.

(k) Shipping and Handling Costs

Shipping and handling costs are included in cost of revenue.

(l) Stock-Based Compensation

We generally recognize compensation expense for all stock-based payments to employees and directors, including grants of stock options and restricted stock units, based on the grant-date fair value of those stock-based payments. For stock option awards, we use the Black-Scholes option pricing model, adjusted for expected forfeitures. Other valuation models may be utilized in the limited circumstances where awards with market-based vesting considerations, such as the price of our common stock, or performance-based awards, are granted. Stock-based compensation expense is recognized ratably over the requisite service period. For each stock option or restricted stock unit grant with vesting based on a combination of time, market or performance conditions, where vesting will occur if either condition is met, the related compensation costs are recognized over the shorter of the explicit service period or the derived service period.

See Note 13 for additional information relating to stock-based compensation.

(m) Income Taxes

We record income taxes using the asset and liability method. Deferred income 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 income tax basis, and operating loss and tax credit carryforwards.

Our consolidated financial statements contain certain deferred tax assets which have arisen primarily as a result of operating losses, as well as other temporary differences between financial and tax accounting. We establish a valuation allowance if the likelihood of realization of the deferred tax assets is reduced based on an evaluation of objective verifiable evidence. Significant management judgment is required in determining our provision for income taxes, our deferred tax assets and liabilities and any valuation allowance recorded against those net deferred tax assets. We evaluate the weight of all available evidence to determine whether it is more likely than not that some portion or all of the net deferred income tax assets will not be realized.

Income taxes include the largest amount of tax benefit for an uncertain tax position that is more likely than not to be sustained upon audit based on the technical merits of the tax position. Settlements with tax authorities, the expiration of statutes of limitations for particular tax positions, or obtaining new information on particular tax positions may cause a change to the effective tax rate. We recognize accrued interest related to unrecognized tax benefits as interest expense and penalties within operating expense in the consolidated statements of operations.

See Note 18 for additional information relating to income taxes.

(n) Computation of Net Income per Share

Basic earnings per share is computed by dividing income available to common stockholders (the numerator) by the weighted-average number of common shares outstanding (the denominator) for the period. The computation of diluted earnings per share is similar to basic earnings per share, except that the denominator is increased to include the number of additional common shares that would have been outstanding if the potentially dilutive common shares had been issued, calculated using the treasury stock method.

The components of net income per share are as follows:

	Year ended December 31,		
	2019	**2018**	**2017**
	(in thousands, except per share data)		
Net income available to common stockholders	$ 17,034	$ 45,885	$ 126,959
Weighted average common shares outstanding used in computing basic income per share	32,559	32,286	30,866
Incremental options and RSUs	1,269	1,716	2,570
Weighted average common shares used in computing diluted net income per share	33,828	34,002	33,436
Net income per share			
Basic	$ 0.52	$ 1.42	$ 4.11
Diluted	$ 0.50	$ 1.35	$ 3.80

Diluted weighted average common shares outstanding does not include restricted stock units outstanding to purchase 0.2 million common equivalent shares for the period ended December 31, 2019, as their effect would have been anti-dilutive.

(o) Accumulated Other Comprehensive Income (Loss)

The following table presents the changes in accumulated other comprehensive income, net of tax, by component for the year ended December 31, 2019:

	Foreign currency	Defined benefit pension plan	Total
		(in thousands)	
Balance at December 31, 2018	$ 962	$ (514)	$ 448
Other comprehensive loss and pension reclassification	(444)	(262)	(706)
Balance at December 31, 2019	$ 518	$ (776)	$ (258)

(p) Recent Accounting Guidance

i. Accounting Standard Update 2016-02 on Leases Adopted January 1, 2019

We adopted Accounting Standards Update ("ASU") No. 2016-02, "*Leases*" and ASU No. 2018-11 "*Leases (Topic 842)*", (collectively "Topic 842") as of January 1, 2019, using the modified retrospective approach, applying the new lease standard at the adoption date. We elected the package of practical expedients permitted under the transition guidance within the new standard, carrying forward the historical lease classification for both operating and finance leases. We made an accounting policy election to keep leases with an initial term of 12 months or less off of the balance sheet. We recognize the lease expense relating to operating leases on a straight-line basis over the respective lease term and report the associated expense within the operating activities section of our statement of cash flows. We recognize the interest expense on our finance lease within the operating activities section of our statement of cash flows and recognize the payment of principal of our finance lease obligation within the financing activities section of our statement of cash flows.

The adoption of Topic 842 resulted in the initial recording of additional net operating lease assets and related lease liabilities of $6.1 million as of January 1, 2019. We also reclassified $22.1 million net, of previously capitalized property, plant and equipment associated with the sale of our corporate headquarters, as well as $0.8 million of prepaid transaction costs, as finance lease assets, within our balance sheet. The related finance lease liability associated with the sale-leaseback increased $0.8 million as a result of the reclassification of the prepaid transaction costs. The standard had no impact on our consolidated net earnings and cash flows. See Note 9 for further discussion.

ii. Accounting Standards Update 2018-13 on Fair Value Measurements Adopted January 1, 2019

We adopted ASU No. 2018-13 *"Fair Value Measurement (Topic 820)"* as of January 1, 2019, The amendments in ASU No. 2018-13 modify the disclosure requirements on fair value measurements in Topic 820, removing disclosure requirements for transfers between Level 1 and Level 2 within the fair value hierarchy, as well as modifying the disclosure requirement relating to the timing of liquidation for investments calculated on net asset value. The ASU also requires the disclosure of unrealized gains and losses for the period included in other comprehensive income for Level 3 instruments. The amendments on changes for unrealized gains and losses should be applied prospectively for only the most recent interim or annual period presented in the initial fiscal year of adoption. The adoption of ASU 2018-13 did not have any impact on our consolidated financial statements and disclosures.

iii. Accounting Standards Update 2019-04 on Financial Instruments; Topic 326, Topic 815 and Topic 825 to be Effective January 1, 2020

In April 2019, the Financial Accounting Standards Board issued ASU No. 2019-04 *"Codification Improvements to Topic 326, Financial Instruments – Credit Losses, Topic 815, Derivatives and Hedging, and Topic 825, Financial Instruments."* The amendments in this Update clarify the guidance within Topic 326 relating to credit losses. The guidance is effective for annual reporting periods beginning after December 15, 2019, and interim periods within those years. Early adoption is permitted in any interim period after issuance of this Update as long as the entity has adopted the amendments in Update 2016-13. The amendments in these Updates should be applied on a modified retrospective basis by means of a cumulative-effect adjustment to the opening retained earnings balance in the statement of financial position as of the date of adoption of Update 2016-13. We will adopt these Updates as of January 1, 2020. The adoption is not expected to have a material impact on our results of operations or cash flows.

Note 3. Revenue

We design, manufacture and service ion implantation and other processing equipment used in the fabrication of semiconductor chips and sell our products to leading semiconductor chip manufacturers worldwide. We offer a complete line of high energy, high current and medium current implanters for all application requirements. In addition, we provide extensive aftermarket lifecycle products and services, including used tools, spare parts, equipment upgrades, maintenance service and customer training. Our revenue recognition policies are set forth in Section (i) of Note 2, Summary of Significant Accounting Policies.

(a) **Alternative Operational Revenue Categories used by Management**

To reflect the organization of our business operations, management reviews revenue in two categories: revenue from sales of new systems and revenue arising from the sale of used systems, parts and labor to customers who own systems, which we refer to as "aftermarket."

Below are the revenues by categories used by management for the periods covered in this report:

	Year ended December 31,		
	2019	**2018**	**2017**
	(in thousands)		
Systems	$ 202,571	$ 280,388	$ 262,688
Aftermarket	140,387	162,187	147,873
	$ 342,958	$ 442,575	$ 410,561

(b) **Economic Factors Affecting our Revenue: Geographic Breakdown of Revenue**

Global economic conditions have a direct impact on our revenue. We are substantially dependent on sales of our products and services to customers outside the United States. Adverse economic conditions, political instability, potential adverse tax consequences and volatility in exchange rates pose a risk that our clients may reduce, postpone or cancel spending for our products and services, which would impact our revenue.

Revenue by geographic markets is determined based upon the location to which our products are shipped and where our services are performed. Revenue in our principal geographic markets is as follows:

	Year ended December 31,		
	2019	**2018**	**2017**
	(in thousands)		
North America	$ 36,206	$ 54,790	$ 59,825
Asia Pacific	251,020	326,191	296,481
Europe	55,732	61,594	54,255
	$ 342,958	$ 442,575	$ 410,561

(c) **Recognition of Deferred Revenue from Contract Liabilities**

Contract assets and contract liabilities are as follows:

	Year ended December 31,		
	2019	2018	2017
	(in thousands)		
Balance, beginning of the period	$ 22,584	$ 18,145	$ 11,009
Deferral of revenue	24,403	17,284	16,658
Recognition of deferred revenue	(17,736)	(12,845)	(9,522)
Balance, ending of the period	$ 29,251	$ 22,584	$ 18,145

Contract liabilities are reflected as deferred revenue on the consolidated balance sheet. Contract liabilities relate to payments received or amounts invoiced in advance of completion of performance obligations under a contract. Contract liabilities are recognized as revenue upon the fulfillment of performance obligations.

As of December 31, 2019, we had deferred revenue of $29.3 million. This represents the portion of the transaction price for contracts with customers allocated to the performance obligations that remain unsatisfied or partially unsatisfied. Short-term deferred revenue of $24.6 million as of December 31, 2019 represents performance obligations that will be satisfied within the next 12 months. This amount relates primarily to prepayments made prior to system delivery as well as to installation and non-standard warranty performance obligations for system sales. Long-term deferred revenue of $4.7 million as of December 31, 2019 relates primarily to extended warranty performance obligations that we expect to be completed within the next 24 months.

The majority of our system transactions have payment terms that are 90% due upon shipment of the tool and 10% due upon installation. Aftermarket transaction payment terms are such that payment is due either within 30 or 60 days of service provided or delivery of parts.

Note 4. Cash, cash equivalents and restricted cash

	December 31, 2019	December 31, 2018
	(in thousands)	
Cash and cash equivalents	$ 139,881	$ 177,993
Long-term restricted cash	6,653	6,909
Total cash, cash equivalents and restricted cash	$ 146,534	$ 184,902

As of December 31, 2019, we had $6.7 million in restricted cash which relates to a $5.9 million letter of credit associated with the security deposit for the sale leaseback transaction, a $0.7 million letter of credit relating to workers' compensation insurance and a $0.1 million deposit relating to customs activity.

Note 5. Accounts Receivable, net

The components of accounts receivable are as follows:

	December 31,	
	2019	2018
	(in thousands)	
Trade receivables	$ 84,571	$ 78,727
Allowance for doubtful accounts	(818)	—
Trade receivables, net	$ 83,753	$ 78,727

We record an allowance for doubtful accounts for estimated losses resulting from the inability of our customers to make required payments. Our allowance for doubtful accounts is established based on a specific assessment of collectability of our customer accounts. If the financial condition of our customers were to deteriorate, resulting in an impairment of their ability to make payments, additional allowance may be necessary.

Note 6. Inventories, net

The components of inventories are as follows:

	December 31,	
	2019	2018
	(in thousands)	
Raw materials	$ 95,867	$ 91,875
Work in process	32,131	23,857
Finished goods (completed systems)	12,366	13,268
Inventories, net	$ 140,364	$ 129,000

When recorded, inventory reserves are intended to reduce the carrying value of inventories to their net realizable value. We establish inventory reserves when conditions exist that indicate inventory may be in excess of anticipated demand or is obsolete based upon assumptions about future demand for our products or market conditions. We regularly evaluate our ability to realize the value of inventories based on a combination of factors including the following: forecasted sales or usage, estimated product end of life dates, estimated current and future market value and new product introductions. Purchasing and usage alternatives are also explored to mitigate inventory exposure. In 2019, we recorded a net decrease of $5.7 million in inventory reserves. As of December 31, 2019 and 2018, inventories are stated net of inventory reserves of $8.2 million and $13.9 million, respectively.

During the years ended December 31, 2019, 2018 and 2017, we recorded charges to cost of sales of $2.8 million, $2.2 million and $8.1 million, respectively, to reflect the lower of cost or net realizable value.

We have inventory on consignment at customer locations as of December 31, 2019 and 2018, of $5.0 million and $4.6 million, respectively.

Note 7. Property, Plant and Equipment, net

The components of property, plant and equipment are as follows:

	December 31, 2019	December 31, 2018
	(in thousands)	
Land and buildings	$ 7,365	$ 75,904
Machinery and equipment	28,732	19,982
Construction in process	4,612	6,366
Total cost	40,709	102,252
Accumulated depreciation	(15,381)	(61,103)
Property, plant and equipment, net	$ 25,328	$ 41,149

Upon the adoption of Topic 842 on January 1, 2019, $70.1 million of land and buildings and their related accumulated depreciation of $48.0 million was reclassified to finance lease assets, net on the consolidated balance sheet.

See Note 9 for further discussion.

Depreciation expense was $2.6 million, $3.2 million and $2.2 million for the years ended December 31, 2019, 2018 and 2017, respectively.

Note 8. Assets Manufactured for Internal Use, net

Assets manufactured for internal use, included in other assets, are depreciated using the straight-line method over their 10 year estimated useful life. Their components are as follows:

	December 31, 2019	December 31, 2018
	(in thousands)	
Internal use assets	$ 56,775	$ 47,509
Construction in process	5,242	1,609
Total cost	62,017	49,118
Accumulated depreciation	(19,259)	(19,285)
Assets manufactured for internal use, net	$ 42,758	$ 29,833

These products are used for research and development, training, and customer demonstration purposes.

Depreciation expense was $3.9 million, $2.6 million and $2.8 million for the years ended December 31, 2019, 2018 and 2017, respectively.

Note 9. Leases

We have operating leases for office space, warehouse space, computer and office equipment and vehicles used in our business operations. We have a finance lease in relation to the 2015 sale-leaseback of our corporate headquarters in Beverly, Massachusetts. We review all agreements to determine if the agreement contains a lease component. An agreement contains a lease component if it provides the use of a specific physical space or a specific physical item.

Upon adoption of Topic 842 on January 1, 2019, we recognized operating lease obligations on a discounted basis using the explicit or implicit discount rate stated within the agreement. We recognize a corresponding right-of-use asset, which is initially determined based upon the net present value of the associated liability and is adjusted for deferred costs and possible impairment, if any. For those lease agreements that do not indicate the applicable discount rate, we use our incremental borrowing rate. The value of the right-of-use asset is initially determined based on the net present value of the associated liability, and is adjusted for deferred costs and possible impairments, if any. We have made the following policy elections: (i) operating leases with an initial term of 12 months or less are not recorded on the consolidated balance sheet; (ii) we recognize lease expense for operating leases on a straight-line basis over the lease term; and (iii) we account for lease components and non-lease components that are fixed payments as one component. Some of our operating leases include one or more options to renew, with renewal terms that can extend the respective lease term 1 to 3 years. The exercise of lease renewal options is at our sole discretion. For lease extensions that are reasonably certain to occur, we have included the renewal periods in our calculation of the net present value of the lease obligation and related right-of-use asset. Certain leases also include options to purchase the leased property. The depreciable life of certain assets and leasehold improvements are limited by the expected lease term, unless there is a transfer of title or purchase option reasonably certain of exercise. Our lease agreements do not contain any material residual value guarantees or material restrictive covenants. The amounts of operating and finance lease right-of-use assets and related lease obligations recorded within our consolidated balance sheet are as follows:

Leases	**Classification**	**December 31, 2019**
Assets		**(in thousands)**
Operating lease	Operating lease assets	$ 5,849
Finance lease	Finance lease assets *	21,880
Total leased assets		$ 27,729
Liabilities		
Current		
Operating	Other current liabilities	$ 3,144
Finance	Current portion of finance lease obligation	399
Noncurrent		
Operating	Other long-term liabilities	2,553
Finance	Finance lease obligation	48,149
Total lease liabilities		$ 54,245

* Finance lease assets are recorded net of accumulated depreciation of $47.4 million and include $0.7 million of prepaid financing costs as of December 31, 2019.

All of our office locations support selling and servicing functions. Lease expense, depreciation expense relating to finance leased assets and interest expense relating to our finance lease obligation recognized within our consolidated statement of operations for the twelve months ended December 31, 2019 are as follows:

Lease cost	**Classification**	**Year ended December 31, 2019**
Operating lease cost		**(in thousands)**
Service	Cost of revenue	$ 2,315
Research and development	Operating expenses	313
Sales and marketing*	Operating expenses	1,378
General and administrative*	Operating expenses	788
Total operating lease cost		$ 4,794
Finance lease cost		
Depreciation of leased assets	Cost of revenue, R&D, Sales and marketing and G&A	$ 1,348
Interest on lease liabilities	Interest expense	5,155
Total finance lease cost		$ 6,503
Total lease cost		$ 11,297

* Sales and marketing, general and administrative expense includes short-term lease and variable lease costs of approximately $0.9 million for the twelve months ended December 31, 2019.

Our corporate headquarters, shown below under finance leases, has an original lease term of 22 years. All other locations are treated as operating leases, with lease terms ranging from 1 to 10 years. The tables below reflect the minimum cash outflow regarding our current lease obligations as well as the weighted-average remaining lease term and weighted-average discount rates used on our calculation of our lease obligations and right-of-use assets:

Maturity of Lease Liabilities	Finance Leases	Operating Leases	Total Leases
		(in thousands)	
2020	$ 5,720	$ 3,511	$ 9,231
2021	5,848	1,838	7,686
2022	5,980	637	6,617
2023	6,114	128	6,242
2024	6,252	68	6,320
Thereafter	79,653	206	79,859
Total lease payments	$ 109,567	$ 6,388	$ 115,955
Less interest portion*	(61,019)	(691)	(61,710)
Finance lease and operating lease obligations	$ 48,548	$ 5,697	$ 54,245

* Finance lease interest calculated using the implied interest rate; operating lease interest calculated using estimated corporate borrowing rate.

Lease term and discount rate	December 31, 2019
Weighted-average remaining lease term (years):	
Operating leases	2.4
Finance leases	17.1
Weighted-average discount rate:	
Operating leases	4.5%
Finance leases	10.5%

Our cash outflows from our operating leases include rent expense and other charges associated with these leases. These cash flows are included within the operating section of our statement of cash flows. Our cash flows from our finance lease currently include an interest only component and starting in April 2020, both an interest and payment of principal component. The table below shows our cash outflows, by lease type and related section of our statement of cash flows as well as the non-cash amount capitalized on our balance sheet in relation to our operating lease right-of-use assets:

Cash paid for amounts included in the measurement of lease liabilities	Year ended December 31, 2019
	(in thousands)
Operating cash outflows from operating leases	$ 4,794
Operating cash outflows from finance leases	5,594
Financing cash outflows from finance leases	—
Operating lease assets obtained in exchange for new operating lease liabilities	5,849
Finance lease assets obtained in exchange for new finance lease liabilities	$ —

Note 10. Product Warranty

We generally offer a one year warranty for all of our systems, the terms and conditions of which vary depending upon the product sold. For all systems sold, we accrue a liability for the estimated cost of standard warranty at the time of system shipment and defer the portion of systems revenue attributable to the fair value of non-standard warranty. Costs for non-standard warranty are expensed as incurred. Factors that affect our warranty liability include the number of installed units, historical and anticipated product failure rates, material usage and service labor costs. We periodically assess the adequacy of our recorded liability and adjust the amount as necessary.

The changes in our product warranty liability are as follows:

	Year ended December 31, 2019	2018	2017
	(in thousands)		
Balance at January 1 (beginning of year)	$ 5,091	$ 4,502	$ 2,666
Warranties issued during the period	3,615	5,421	5,671
Settlements made during the period	(5,548)	(5,903)	(2,603)
Changes in estimate of liability for pre-existing warranties during the period	86	1,071	(1,232)
Balance at December 31 (end of period)	$ 3,244	$ 5,091	$ 4,502
Amount classified as current	$ 2,759	$ 4,819	$ 4,112
Amount classified as long-term	485	272	390
Total warranty liability	$ 3,244	$ 5,091	$ 4,502

Note 11. Financing Arrangements

Sale Leaseback Obligation

On January 30, 2015, we sold our corporate headquarters facility for the sale price of $48.9 million. As part of the sale, we also entered into a 22-year lease agreement with the buyer. The sale leaseback is accounted for as a financing arrangement for financial reporting and, as such, we recorded a financing obligation of $48.5 million as of December 31, 2019, $0.4 million of which is classified within current liabilities. The associated lease payments include both an interest component and payment of principal, with the underlying liability being extinguished at the end of the original lease term. We posted a collateralized security deposit of $5.9 million in the form of an irrevocable letter of credit at the time of the closing. In October 2015, this letter of credit was cash collateralized.

Note 12. Employee Benefit Plans

(a) Defined Contribution Plan

We maintain the Axcelis Long-Term Investment Plan, a defined contribution plan. Eligible employees may contribute up to 35% of their compensation on a before-tax basis subject to Internal Revenue Service (“IRS”) limitations. Highly compensated employees may contribute up to 16% of their compensation on a before-tax basis subject to IRS limitations. In 2019, 2018 and 2017 we provided an employer match of 50% of employees’ pre-tax contributions on the first 6% of eligible compensation. Total related matching contribution expense was $1.9 million, $1.6 million and $1.2 million, for 2019, 2018 and 2017, respectively.

(b) Other Compensation Plans

We operate in foreign jurisdictions that require lump sum benefits, payable based on statutory regulations, for voluntary or involuntary termination. Where required, an annual actuarial valuation of the benefit plans is obtained.

We have recorded an unfunded liability of $4.8 million and $4.3 million at December 31, 2019 and 2018, respectively, for costs associated with these compensation plans in foreign jurisdictions. The following table presents the classification of these liabilities in the Consolidated Balance Sheets:

	Year ended December 31, 2019	2018
	(in thousands)	
Current:		
Accrued compensation	$ 1,040	$ 973
Total current liabilities	$ 1,040	$ 973
Long-term:		
Other long-term liabilities	3,753	3,327
Total liabilities	$ 4,793	$ 4,300

The expense recorded in connection with these plans was $1.2 million, $1.3 million and $1.0 million during the years ended December 31, 2019, 2018 and 2017, respectively.

Note 13. Stock Award Plans and Stock Based Compensation

(a) Equity Incentive Plans

We maintain the Axcelis Technologies, Inc. 2012 Equity Incentive Plan (the “2012 Equity Plan”), which became effective on May 2, 2012. Our 2000 Stock Plan (the “2000 Stock Plan”) expired on May 1, 2012 and no new grants may be made under that plan after that date. However, awards granted under the 2000 Stock Plan prior to the expiration remain outstanding and subject to the terms of the 2000 Stock Plan.

The 2012 Equity Plan, as amended, reserves 9.5 million shares of common stock, $0.001 par value, for grant and permits the issuance of options, stock appreciation rights, restricted stock, restricted stock units, stock equivalents and awards of shares of common stock that are not subject to restrictions or forfeiture to selected employees, directors and consultants of the Company. The 2012 Equity Plan includes shares specifically approved by the stockholders of the Company. Shares that are not issued under an award (because such award expires, is terminated unexercised or is forfeited) revert back to the Plan. The reserve under the Plan is also increased by expirations and forfeitures of awards outstanding under the 2000 Stock Plan as of May 2, 2012.

The term of stock options granted under these plans is specified in the award agreements. Unless a lesser term is otherwise specified by the Compensation Committee of the Company’s Board of Directors, awards under the 2012 Equity Plan will expire seven years from the date of grant. In general, all awards issued under the 2000 Stock Plan expire ten years from the date of grant. Under the terms of these stock plans, the exercise price of a stock option may not be less than the fair market value of a share of the Company’s common stock on the date of grant. Under the 2012 Equity Plan, fair market value is defined as the last reported sale price of a share of the common stock on a national securities exchange as of any applicable date, as long as the Company’s shares are traded on such exchange.

Stock options granted to employees generally vest over a period of four years, while stock options granted to non-employee members of the Company’s Board of Directors generally vest over a period of six months and, once vested, are not affected by the director’s termination of service to the Company. In limited circumstances, the Company may grant stock option awards with market-based vesting conditions, such as the Company’s common stock price, or other performance conditions. Termination of service by an employee will cause options to cease vesting as of the date of termination, and in most cases, employees will have 90 days after termination to exercise options that were vested as of the termination of employment. In general, retiring employees will have one year after termination of employment to exercise vested options. The Company settles stock option exercises with newly issued common shares.

Restricted stock units granted to employees during 2019 had both service-based vesting provisions and performance-based vesting provisions. Restricted stock units granted to employees generally vest over a service period of four years, while restricted stock units granted to non-employee members of the Company’s Board of Directors generally vest over a service period of six months. We have granted restricted stock units to executive officers and other senior employees with performance vesting conditions, which may be subject to further service-based vesting terms. Unvested restricted stock unit awards expire upon termination of service to the Company. We settle restricted stock units upon vesting with newly issued common shares. No restricted stock was granted under either stock plan during the three year period ended December 31, 2019.

As of December 31, 2019, there were 2.7 million shares available for grant under the 2012 Equity Plan. No shares are available for grant under the 2000 Stock Plan.

As of December 31, 2019, there were 1.5 million options outstanding under the 2012 Equity Plan and the 2000 Stock Plan, collectively, and 1.1 million unvested restricted stock units outstanding under the 2012 Stock Plan.

(b) Employee Stock Purchase Plan

The Employee Stock Purchase Plan (the “Purchase Plan”) provides effectively all of our employees the opportunity to purchase common stock of the Company at less than market prices. Purchases are made through payroll deductions of up to 10% of the employee’s salary as elected by the participant, subject to certain caps set forth in the Purchase Plan. Employees may purchase the Company’s common stock at 85% of its market price on the day the stock is purchased.

The Purchase Plan is considered compensatory and as such, compensation expense has been recognized based on the benefit of the discounted stock price, amortized to compensation expense over each offering period of six months. Compensation expense relating to the Purchase Plan was approximately $0.2 million for the years ended December 31, 2019 and December 31, 2018 and approximately $0.1 million for the year ended December 31, 2017.

As of December 31, 2019, there were a total of 0.2 million shares reserved for issuance and available for purchase under the Purchase Plan. Less than 0.1 million shares were purchased under the Purchase Plan in each of the years ended December 31, 2019, 2018 and 2017. The Purchase Plan will expire in June 2020, unless re-approved by the Board of Directors, with approval of stockholders within twelve months thereafter.

(c) Valuation of Stock Options and Restricted Stock Units

For the purpose of valuing stock options with service conditions, we use the Black-Scholes option pricing model to calculate the grant-date fair value of an award. There were no stock option awards granted in 2019, 2018 and 2017.

The fair value of the Company’s restricted stock units is calculated based upon the fair market value of the Company’s stock at the date of grant.

(d) Summary of Stock-based Compensation Expense

We use the straight-line attribution method to recognize expense for stock-based awards such that the expense associated with awards is evenly recognized throughout the period.

The amount of stock-based compensation recognized is based on the value of the portion of the awards that are ultimately expected to vest. We estimate forfeitures at the time of grant and revise them, if necessary, in subsequent periods if actual forfeitures differ from those estimates. The term “forfeitures” is distinct from “cancellations” or “expirations” and represents only the unvested portion of the surrendered stock-based award. Based on a historical analysis, a forfeiture rate of 5% per year was applied to stock-based awards, including executive officer awards, for the years ended December 31, 2019, 2018 and 2017.

For the years ended December 31, 2019, 2018 and 2017, we recognized stock-based compensation expense of $8.2 million, $7.8 million and $5.7 million, respectively. We present the expenses related to stock-based compensation in the same expense line items as cash compensation paid to our employees. For the years ended December 31, 2019, 2018 and 2017, we used restricted stock units in our annual equity compensation program.

The benefit of tax deductions in excess of recognized compensation cost is reported as an operating cash flow. Axcelis had tax deductions in excess of recognized compensation cost of $7.3 million for the year ended December 31, 2019 which resulted in a tax benefit of $1.5 million.

(e) Stock Option Awards

The following table summarizes the stock option activity for the year ended December 31, 2019:

	Options (in thousands)	Weighted Average Exercise Price	Weighted Average Remaining Contractual Term (years)	Aggregate Intrinsic Value (in thousands)
Outstanding at December 31, 2018	2,285	$ 8.12		
Granted	—	—		
Exercised	(775)	6.59		
Canceled	(1)	12.04		
Expired	(3)	3.72		
Outstanding at December 31, 2019	1,506	$ 8.92	1.67	$ 22,856
Exercisable at December 31, 2019	1,496	$ 8.89	1.66	$ 22,760
Options Vested or Expected to Vest at December 31, 2019(1)	1,506	$ 8.91	1.69	$ 22,852

(1) In addition to the vested options, we expect a portion of the unvested options to vest at some point in the future. Options expected to vest is calculated by applying an estimated forfeiture rate to the unvested options.

The total intrinsic value, which is defined as the difference between the market price at exercise and the price paid by the employee to exercise the options, for options exercised during the years ended December 31, 2019, 2018 and 2017 was $10.9 million, $4.1 million and $39.7 million, respectively.

The total fair value of stock options vested during the years ended December 31, 2019, 2018 and 2017 was $0.9 million, $1.9 million and $3.1 million respectively. As of December 31, 2019, there was $0.1 million of total forfeiture-adjusted unrecognized compensation cost related to non-vested stock options granted under the 2012 Equity Incentive Plan and the 2000 Stock Plan. That cost is expected to be recognized over a weighted-average period of 0.9 years.

(f) Restricted Stock Units and Restricted Stock

Restricted stock units represent the Company’s unfunded and unsecured promise to issue shares of the common stock at a future date, subject to the terms of the Award Agreement issued under the 2012 Equity Incentive Plan. Restricted stock unit awards granted in 2019 included time vested share awards and awards with performance vesting conditions. Restricted stock awards are issued shares of common stock that are subject to forfeiture on terms described in the Award Agreement, and may be granted under the 2012 Equity Incentive Plan. No restricted stock awards were granted, or vested, during the years ended December 31, 2019, 2018 and 2017. The fair value of a restricted stock unit and restricted stock award is charged to expense ratably over the applicable service period. The purpose of these awards is to assist in attracting and retaining highly competent employees and directors and to act as an incentive in motivating selected employees and directors to achieve long-term corporate objectives.

Changes in the Company’s non-vested restricted stock units for the year ended December 31, 2019 is as follows:

	Shares/units (in thousands)	Weighted-Average Grant Date Fair Value per Share
Outstanding at December 31, 2018	820	$ 18.76
Granted	681	17.08
Vested	(343)	17.42
Forfeited	(36)	18.79
Outstanding at December 31, 2019	1,122	$ 18.15

The weighted average grant-date fair value of restricted stock units granted for the years ended December 31, 2019, 2018 and 2017 was $17.08, $22.41 and $20.72, respectively. Most restricted stock units provide for net share settlement to cover the employee’s personal income tax withholding obligations on vesting of the employee’s restricted stock units. Vesting activity above reflects shares vested before net share settlement. As of December 31, 2019, there was $14.2 million of total forfeiture-adjusted unrecognized compensation cost related to non-vested restricted stock units granted under the 2012 Equity Incentive Plan. That cost is expected to be recognized over a weighted-average period of 2.6 years.

Note 14. Stockholders’ Equity

We may issue up to 75 million shares of common stock without additional shareholder approval. As of December 31, 2019 and 2018, there were 32.6 million outstanding shares of common stock.

On December 3, 2019 we announced that our Board of Directors authorized an increase and extension of the share repurchase program, of up to $50 million of the Company's common stock through 2020. These shares may be purchased in the open market or through privately negotiated transactions.

As of December 31, 2019, $32.3 million remained available for stock repurchases pursuant to this program. The pace of our repurchase activity will depend on factors such as our working capital needs, our cash requirements for business development, our stock price, and economic and market conditions. Our stock repurchases may be effected from time to time through open market purchases or pursuant to a Rule 10b5-1 plan. Our stock repurchase program may be accelerated, suspended, delayed or discontinued at any time. We have no obligation to repurchase shares under the authorization, and the timing and actual number and value of shares which are repurchased will depend on a number of factors, including the price of the Company's common stock, general business and market conditions, and alternative investment opportunities. We may suspend or discontinue the repurchase program at any time.

Note 15. Fair Value Measurements

Fair value is defined as the exchange price that would be received for an asset or paid to transfer a liability (an exit price) in the principal or most advantageous market for the asset or liability in an orderly transaction between market participants on the measurement date.

(a) Fair Value Hierarchy

The accounting guidance for fair value measurement requires an entity to maximize the use of observable inputs and minimize the use of unobservable inputs when measuring fair value. The standard establishes a fair value hierarchy based on the level of independent, objective evidence surrounding the inputs used to measure fair value. A financial instrument’s categorization within the fair value hierarchy is based upon the lowest level of input that is significant to the fair value measurement. The fair value hierarchy is as follows:

Level 1—applies to assets or liabilities for which there are quoted prices in active markets for identical assets or liabilities.

Level 2—applies to assets or liabilities for which there are inputs other than quoted prices that are observable for the asset or liability, such as quoted prices for similar assets or liabilities in active markets; quoted prices for identical assets or liabilities in markets with insufficient volume or infrequent transactions (less active markets); or model-derived valuations in which significant inputs are observable or can be derived principally from, or corroborated by, observable market data.

Level 3—applies to assets or liabilities for which there are unobservable inputs to the valuation methodology that are significant to the measurement of the fair value of the assets or liabilities.

(b) Assets and Liabilities Measured at Fair Value

Our money market funds and short-term investments are included in cash and cash equivalents in the consolidated balance sheets.

The following table sets forth Company's assets which are measured at fair value by level within the fair value hierarchy.

	December 31, 2019 Fair Value Measurements			
	Level 1	Level 2	Level 3	Total
	(in thousands)			
Assets				
Cash equivalents:				
Money market funds, U.S. Government Securities and Agency Investments	$ 92,872	$ 24,000	$ —	$ 116,872

	December 31, 2018 Fair Value Measurements			
	Level 1	Level 2	Level 3	Total
	(in thousands)			
Assets				
Cash equivalents:				
Money market funds, U.S. Government Securities and Agency Investments	$ 138,510	$ 21,700	$ —	$ 160,210

(c) Other Financial Instruments

The carrying amounts reflected in the consolidated balance sheets for accounts receivable, prepaid expenses and other current and non-current assets, restricted cash, accounts payable and accrued expenses approximate fair value due to their short-term maturities.

Note 16. Commitments and Contingencies

(a) Lease Commitments

We lease manufacturing and office facilities and certain equipment under operating and capital leases that expire through 2037. Rental expense was $4.8 million, $4.6 million and $3.9 million under operating leases for the years ended December 31, 2019, 2018 and 2017, respectively. Future minimum lease commitments on non-cancelable operating leases for the year ended December 31, 2019 are as follows:

	Operating Leases (in thousands)
2020	$ 3,511
2021	1,838
2022	637
2023	128
2024	68
Thereafter	206
Total operating lease payments	$ 6,388

(b) Sale Leaseback Financing Obligation

In addition to the lease commitments as described above, in 2015 we entered into a 22-year lease agreement relating to our corporate headquarters in Beverly, Massachusetts. The following table relates to the cash payment schedule associated with this lease obligation as of December 31, 2019:

	Lease Obligation (in thousands)
2020	$ 5,720
2021	5,848
2022	5,980
2023	6,114
2024	6,252
Thereafter	79,653
Total finance lease payments	$ 109,567
Less interest portion	(61,019)
Sale leaseback obligation	$ 48,548

(c) Purchase Commitments

We have contracts and purchase orders for inventory and other expenditures of $62.4 million at December 31, 2019.

(d) Litigation

We are not presently a party to any litigation that we believe might have a material adverse effect on our business operations. We are, from time to time, a party to litigation that arises in the normal course of our business operations.

(e) Indemnifications

Our system sales agreements typically include provisions under which we agree to take certain actions, provide certain remedies and defend our customers against third-party claims of intellectual property infringement under specified conditions and to indemnify customers against any damage and costs awarded in connection with such claims. We have not incurred any material costs as a result of such indemnifications and have not accrued any liabilities related to such obligations in the accompanying consolidated financial statements.

Note 17. Business Segment and Geographic Region Information

We operate in one business segment, which is the manufacture of capital equipment for the semiconductor chip manufacturing industry. The principal market for semiconductor capital equipment is semiconductor chip manufacturers. Substantially all sales are made directly by us to our customers located in the United States, Europe and Asia Pacific.

Our ion implantation systems product line includes high current, medium current and high energy implanters. Other legacy processing products include curing and thermal processing systems. In addition to new equipment, we provide post-sales equipment service and support, including spare parts, equipment upgrades, used equipment, maintenance services and customer training.

Revenue by product lines is as follows:

	Year ended December 31,		
	2019	2018	2017
	(in thousands)		
Ion implantation systems and services	$ 326,029	$ 421,747	$ 391,051
Other systems and services	16,929	20,828	19,510
Total revenue	$ 342,958	$ 442,575	$ 410,561

Revenue and long-lived assets by geographic region, based on the physical location of the operation recording the sale or the asset, are as follows:

	Revenue	Long-Lived Assets
	(in thousands)	
2019		
United States	$ 256,092	$ 67,336
Europe	28,743	—
Asia Pacific	58,123	748
	$ 342,958	$ 68,084
2018		
United States	$ 342,802	$ 70,022
Europe	29,417	—
Asia Pacific	70,356	960
	$ 442,575	$ 70,982
2017		
United States	$ 313,916	$ 56,089
Europe	26,936	—
Asia Pacific	69,709	707
	$ 410,561	$ 56,796

Long-lived assets consist of property, plant and equipment, net, and assets manufactured for internal use, net. Operations in Europe and Asia Pacific consist of sales and service organizations.

International revenue, which includes export sales from U.S. manufacturing facilities to foreign customers and sales by foreign subsidiaries and branches, was $306.6 million (89.4% of total revenue), $388.3 million (87.7% of total revenue) and $348.5 million (84.9% of total revenue) in 2019, 2018 and 2017, respectively.

Note 18. Income Taxes

Income before income taxes is as follows:

	Year ended December 31, 2019	2018	2017
	(in thousands)		
United States	$ 18,148	$ 52,172	$ 40,752
Foreign	2,774	2,533	3,079
Income before income taxes	$ 20,922	$ 54,705	$ 43,831

Provision for income taxes is as follows:

	Year ended December 31, 2019	2018	2017
	(in thousands)		
Current:			
United States			
Federal	$ —	$ 41	$ 430
State	5	112	32
Foreign	579	323	230
Total current	584	476	692
Deferred:			
Federal	3,962	8,108	(82,048)
State	(855)	425	(1,698)
Foreign	197	(189)	(74)
Total deferred	3,304	8,344	(83,820)
Income tax provision (benefit)	$ 3,888	$ 8,820	$ (83,128)

Reconciliation of income taxes at the United States Federal statutory rate to the effective income tax rate is as follows:

	Year ended December 31, 2019	2018	2017
	(in thousands)		
Income taxes at the United States statutory rate	$ 4,393	$ 11,488	$ 15,341
State income taxes	78	299	203
Unrecognized tax benefits	(251)	(345)	(285)
Effect of change in valuation allowance	1,492	(441)	(115,831)
Foreign income tax rate differentials	129	73	(312)
Unremitted earnings of foreign subsidiaries	—	—	(8,933)
Stock options	(1,257)	(715)	(10,342)
Credit expirations	894	—	—
Repatriation of foreign earnings	—	—	4,556
Recognition of equity NOL's	—	—	(1,165)
Rate change	194	160	42,531
Credit generation	(3,124)	(3,530)	(8,778)
Discrete items, net	18	972	31
Other, net	1,322	859	(144)
Income tax provision (benefit)	$ 3,888	$ 8,820	$ (83,128)

Significant components of long-term deferred income taxes are as follows:

	Year ended December 31, 2019	2018
	(in thousands)	
Deferred tax assets:		
Federal net operating loss carryforwards	$ 39,380	$ 42,397
State net operating loss carryforwards	1,211	1,387
Foreign net operating loss carryforwards	554	641
Federal tax credit carryforwards	18,061	16,200
State tax credit carryforwards	6,837	6,489
Property, plant and equipment	10,098	5,924
Operating lease liability	503	—
Accrued compensation	266	97
Inventories	2,674	3,713
Stock compensation	2,477	2,760
Warranty	689	1,090
Deferred revenue	1,086	1,004
Gross deferred tax assets	83,836	81,702
Valuation allowance	(8,327)	(6,835)
Net deferred tax assets	75,509	74,867
Deferred tax liabilities:		
Intangible assets	(47)	(29)
Right-of-use asset	(5,141)	—
Internal Revenue Code 481(a) adjustment	(412)	—
Other	(1,849)	(2,899)
Gross deferred tax liabilities	(7,449)	(2,928)
Deferred taxes, net	$ 68,060	$ 71,939

Changes in tax rates and tax laws are accounted for in the period of enactment. Our deferred tax assets and liabilities are measured at the enacted tax rate expected to apply when these temporary differences are expected to be realized or settled. On December 22, 2017, the Tax Cuts and Jobs Act (“2017 Tax Act”) was signed into law and has resulted in significant changes to the U.S. corporate income tax system. The 2017 Tax Act eliminates the deferral of U.S. income tax on the historical un-repatriated earnings by imposing the Transition Toll Tax, which is a one-time mandatory deemed repatriation tax on undistributed foreign earnings. The Transition Toll Tax is assessed on the U.S. shareholder's share of the foreign corporation's accumulated foreign earnings that have not previously been taxed. Earnings in the form of cash and cash equivalents will be taxed at a rate of 15.5% and all other earnings will be taxed at a rate of 8.0%.

During 2018, the provisional amount for the Toll tax was updated from $4.6 million in 2017 to $3.6 million in 2018 due to refinement of earnings and profits during 2018. We consider our accounting regarding the Transition Toll Tax to be complete. We accrued income tax liabilities of $0.3 million after utilization of foreign tax and research and development credits.

The 2017 Tax Act included a federal statutory rate reduction from 35% to 21%, the elimination or reduction of certain domestic deductions and credits and limitations on the deductibility of interest expense and executive compensation. The 2017 Tax Act also transitioned international taxation from a worldwide system to a modified territorial system and includes base erosion prevention measures on non-U.S. earnings, which has the effect of subjecting certain earnings of our foreign subsidiaries to U.S. taxation as global intangible low-taxed income (“GILTI”). The tax related to GILTI was $0.6 million and $0.4 million for the years ended December 31, 2019 and 2018, respectively. We are treating GILTI as a period cost.

At December 31, 2019, we had $68.1 million of deferred tax assets worldwide relating to net operating loss carryforwards, tax credit carryforwards and other temporary differences, which are available to reduce income taxes in future years. At December 31, 2019, we maintain an $8.3 million valuation allowance in the U.S. against certain tax credits and state net operating losses due to the uncertainty of their realization based on long-term Company forecasts and the expiration dates on these attributes. This represents an increase of $1.5 million from the prior year.

At December 31, 2019, we have federal and state net operating loss carryforwards of $209.5 million and foreign net operating loss carryforwards of $2.1 million expiring principally between 2020 and 2034.

We have research and development and other tax credit carryforwards of $24.9 million at December 31, 2019 that can be used to reduce future federal and state income tax liabilities. These tax credit carryforwards expire principally between 2020 and 2039.

We consider the undistributed earnings of our foreign subsidiaries as of December 31, 2019, to be indefinitely reinvested and, accordingly, no U.S. income taxes have been provided thereon. As of December 31, 2019, the amount of cash associated with indefinitely reinvested foreign earnings was approximately $9.7 million. We have not, nor do we anticipate the need to, repatriate funds to the United States to satisfy domestic liquidity needs arising in the ordinary course of business, including liquidity needs associated with our domestic debt service requirements.

We and our subsidiaries file income tax returns in the U.S. federal jurisdiction and various states and foreign jurisdictions. We and most foreign subsidiaries are subject to income tax examinations by tax authorities for all years dating back to 2008. Our policy is to recognize interest related to unrecognized tax benefits as interest expense and penalties as operating expenses. We believe that we have appropriate support for the income tax positions taken and to be taken on our tax returns and that our accruals for tax liabilities are adequate for all open years based on an assessment of many factors including past experience and interpretations of tax law applied to the facts of each matter.

At December 31, 2019, we had unrecognized tax benefits related to uncertain tax positions of approximately $9.8 million, of which approximately $9.4 million reduced the Company’s deferred tax assets and the offsetting valuation allowance and $0.4 million was recorded in other long-term liabilities. During the first quarter of 2019, the statute of limitations associated with a tax position previously taken by the Company expired. The related tax reserve of $0.2 million and accrued interest of $0.1 million that had been recorded were reversed during the twelve months ended December 31, 2019.

A reconciliation of the beginning and ending balance of unrecognized tax benefits are as follows:

	Year ended December 31,		
	2019	**2018**	**2017**
		(in thousands)	
Balance at beginning of year	$ 9,127	$ 9,105	$ 6,844
Increase / (decrease) in unrecognized tax benefits as a result of tax positions taken during a prior period	215	(132)	81
Reductions to unrecognized tax benefits as a result of a lapse of the applicable statute of limitation	(334)	(543)	(511)
Increases in unrecognized tax benefits as a result of tax positions taken during the current period	791	697	2,691
Balance at end of year	$ 9,799	$ 9,127	$ 9,105
Recorded as other long-term liability	$ 409	$ 676	$ 1,109
Recorded as a decrease in deferred tax assets and offsetting valuation allowance	9,390	8,451	7,996
Balance at end of year	$ 9,799	$ 9,127	$ 9,105

As of December 31, 2019 we had $9.8 million of unrecognized tax benefits which, if recognized would reduce the effective tax rate.

Note 19. Quarterly Results of Operations (unaudited)

	Dec. 31, 2019	Sept. 30, 2019	June 30, 2019	March 31, 2019	Dec. 31, 2018	Sept. 30, 2018	June 30, 2018	March 31, 2018
	(in thousands, except per share data)							
Revenue	$ 107,723	$ 69,453	$ 74,305	$ 91,477	$ 105,683	$ 95,374	$ 119,333	$ 122,185
Gross profit	44,316	30,581	31,749	37,506	43,567	39,913	49,000	47,156
Net income	9,712	704	556	6,062	8,463	8,838	14,669	13,915
Net income per basic share	$ 0.30	$ 0.02	$ 0.02	$ 0.19	$ 0.26	$ 0.27	$ 0.46	$ 0.43
Net income per diluted share	$ 0.29	$ 0.02	$ 0.02	$ 0.18	$ 0.25	$ 0.26	$ 0.43	$ 0.41

Schedule II—Valuation and Qualifying Accounts
Axcelis Technologies, Inc.
(In thousands)

	Balance at Beginning of Period	Charged to Costs and Expenses	Deductions	Balance at End of Period
Year ended December 31, 2019				
Allowance for doubtful accounts and returns	$ —	$ 818	$ —	$ 818
Deferred tax valuation allowance	6,835	1,492	—	8,327
Year ended December 31, 2018				
Allowance for doubtful accounts and returns	$ —	$ —	$ 0	$ —
Deferred tax valuation allowance	7,136	(441)	(140)	6,835
Year ended December 31, 2017				
Allowance for doubtful accounts and returns	$ 77	$ —	$ 77	$ —
Deferred tax valuation allowance	122,966	(115,831)	(1)	7,136

Exhibit Index

Exhibit No.	Description
3.1	Restated Certificate of Incorporation of the Company, filed November 2, 2017. Incorporated by reference to Exhibit 3.1 of the Company's Form 10-Q filed with the Commission on November 3, 2017.
3.2	Bylaws of the Company, as amended and restated as of May 13, 2014. Incorporated by reference to Exhibit 3.2 of the Company's Form 8-K filed with the Commission on May 19, 2014.
4.4	Description of Securities Registered under Section 12 of the Securities Exchange Act of 1934. Filed herewith.
10.1*	Axcelis Technologies, Inc. 2000 Stock Plan, as amended through November 13, 2014. Incorporated by reference to Exhibit 10.1 of the Company's Form 10-K for the year ended December 31, 2014 filed with the Commission on March 11, 2015.
10.2*	Axcelis Technologies, Inc. 2012 Equity Incentive Plan, as approved by stockholders on May 14, 2019. Incorporated by reference to Exhibit 10.1 of the Company's Form S-8 registration statement filed with the Commission on May 21, 2019.
10.3*	Axcelis Management Incentive Plan, as amended and restated by the Compensation Committee of the Board of Directors on February 11, 2010. Incorporated by reference to Exhibit 10.2 of the Company's report on Form 10-K for the year ended December 31, 2009 filed with the Commission on March 15, 2010.
10.4*	Form of Indemnification Agreement approved by the Board of Directors of the Company on February 9, 2012 for use with each of its directors and officers. Incorporated by reference to Exhibit 10.4 of the Company's report on Form 10-K for the year ended December 31, 2011 filed with the Commission on February 29, 2012.
10.5*	Form of Change in Control Agreement, as amended, as approved by the Compensation Committee of the Board of Directors on November 11, 2016, between the Company and each of its executive officers. Incorporated by reference to Exhibit 10.6 of the Company's Form 10-K for the year ended December 31, 2016 filed with the Commission on March 14, 2017.
10.6*	Form of Employee non-qualified stock option grant under the 2000 Stock Plan, updated as of April 5, 2002. Incorporated by reference to Exhibit 10.1 of the Company's report on Form 10-Q filed with the Commission on November 9, 2004.
10.7*	Form of Non-Employee Director stock non-qualified stock option grant under the 2000 Stock Plan, updated as of July 12, 2004. Incorporated by reference to Exhibit 10.2 of the Company's report on Form 10-Q filed with the Commission on November 9, 2004.
10.8*	Form of Employee Non-Qualified Stock Option Certificate under the 2012 Equity Incentive Plan, adopted June 18, 2012. Incorporated by reference to Exhibit 10.2 of the Company's report on Form 10-Q for the quarter ended June 30, 2012 filed with the Commission on August 7, 2012.
10.9*	Form of Non-Employee Director Non-Qualified Stock Option Certificate under the 2012 Equity Incentive Plan, adopted June 18, 2012. Incorporated by reference to Exhibit 10.3 of the Company's report on Form 10-Q for the quarter ended June 30, 2012 filed with the Commission on August 7, 2012.
10.10*	Form of Restricted Stock Unit Award Agreement under the 2012 Equity Incentive Plan, adopted June 18, 2012. Incorporated by reference to Exhibit 10.4 of the Company's report on Form 10-Q for the quarter ended June 30, 2012 filed with the Commission on August 7, 2012.

Exhibit No.	Description
10.11*	Named Executive Officer Base Compensation at March 02, 2020. Filed herewith.
10.12*	Non-Employee Director Cash Compensation at March 02, 2020. Filed herewith.
10.13*	Amended and Restated Employment Agreement between the Company and Mary G. Puma dated November 6, 2007. Incorporated by reference to Exhibit 10.3 of the Company's report on Form 10-Q for the quarter ended September 30, 2007 filed with the Commission on November 8, 2007.
10.14*	Form of Amended and Restated Executive Separation Pay Agreement between the Company and Kevin J. Brewer, William Bintz, John E. Aldeborgh, Russell Low, Lynnette C. Fallon and Douglas Lawson dated May 15, 2019. Incorporated by reference to Exhibit 10.2 of the Company's Form 10-Q for the quarter ended June 30, 2019 filed with the Commission on August 7, 2019.
10.15	Lease Agreement between the Company and Beverly Property Owner LLC, effective January 30, 2015. Incorporated by reference to Exhibit 10.24 of the Company's Form 10-K for the year ended December 31, 2014 filed with the Commission on March 11, 2015.
14.1	Ethical Business Conduct at Axcelis, revised through January 2003. Incorporated by reference to Exhibit 14.1 of the Company's report on Form 10-K filed with the Commission on March 28, 2003.
21.1	Subsidiaries of the Company. Filed herewith.
23.1	Consent of Ernst & Young LLP, Independent Registered Public Accounting Firm. Filed herewith.
31.1	Certification of the Principal Executive Officer under Exchange Act Rule 13a-14(a)/15d-14(a) (Section 302 of the Sarbanes-Oxley Act), dated March 02, 2020. Filed herewith.
31.2	Certification of the Principal Financial Officer under Exchange Act Rule 13a-14(a)/15d-14(a) (Section 302 of the Sarbanes-Oxley Act), dated March 02, 2020. Filed herewith.
32.1	Certification of the Principal Executive Officer pursuant to Section 1350 of Chapter 63 of title 18 of the United States Code (Section 906 of the Sarbanes-Oxley Act), dated March 02, 2020. Filed herewith.
32.2	Certification of the Principal Financial Officer pursuant to Section 1350 of Chapter 63 of title 18 of the United States Code (Section 906 of the Sarbanes-Oxley Act), dated March 02, 2020. Filed herewith.
101	The following materials from the Company's Form 10-K for the year ended December 31, 2019, formatted in eXtensible Business Reporting Language (XBRL): (i) Consolidated Statements of Operations, (ii) Consolidated Statement of Comprehensive Income (iii) Consolidated Balance Sheets, (iv) Consolidated Statements of Equity, (v) Consolidated Statements of Cash Flows, and (vi) Notes to Consolidated Financial Statements.

* Indicates a management contract or compensatory plan.

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.

AXCELIS TECHNOLOGIES, INC.

By: /s/ Mary G. Puma
Mary G. Puma,
President and Chief Executive Officer

Dated: March 02, 2020

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 date indicated.

Signature	Title	Date
/s/ Mary G. Puma Mary G. Puma	Director and Principal Executive Officer	March 02, 2020
/s/ Kevin J. Brewer Kevin J. Brewer	Principal Accounting and Financial Officer	March 02, 2020
/s/ Tzu-Yin Chiu Tzu-Yin Chiu	Director	March 02, 2020
/s/ Richard J. Faubert Richard J. Faubert	Director	March 02, 2020
/s/ R. John Fletcher R. John Fletcher	Director	March 02, 2020
/s/ Arthur L. George, Jr. Arthur L. George Jr.	Director	March 02, 2020
/s/ Joseph P. Keithley Joseph P. Keithley	Director	March 02, 2020
/s/ John T. Kurtzweil John T. Kurtzweil	Director	March 02, 2020
/s/ Thomas St. Dennis Thomas St. Dennis	Director	March 02, 2020
/s/ Jorge Titinger Jorge Titinger	Director	March 02, 2020

Exhibit 4.4

Axcelis Technologies, Inc.

Description of Securities Registered under Section 12 of the Securities Exchange Act of 1934

Our common stock, par value $0.001 per share, stock is the only class of our securities registered under the Exchange Act. We are authorized to issue 75,000,000 shares of common stock. Below is a summary of the material rights of our common stock. This summary is qualified by reference to the provisions of our restated Certificate of Incorporation and amended and restated bylaws, copies of which are filed as exhibits to our Annual Report on Form 10-K.

Issuance	The authorized shares of common stock may be issued by the Board of Directors without further action by our stockholders unless required by applicable law or the rules of any stock exchange on which our securities may be listed or traded.
Voting Rights	The holders of common stock are entitled to one vote per share on all matters submitted to a vote of our stockholders and do not have cumulative voting rights.
Advance notice provisions for stockholder proposals and stockholder nominations of directors.	Our bylaws provide that, for nominations to the Board of Directors or for other business to be properly brought by a holder of common stock before a meeting of stockholders, the stockholder must first have given notice of the proposal in writing to our corporate secretary within the deadlines set forth in the bylaws. Detailed requirements as to the form of the notice and information required in the notice are specified in the bylaws. If it is determined that business was not properly brought before a meeting in accordance with the bylaws, such business will not be conducted at the meeting. The bylaws may have the effect of precluding the conduct of some business at a stockholders' meeting if the proper procedures are not followed or may discourage or defer a potential acquirer from conducting a solicitation of proxies to elect its own slate of directors or otherwise attempting to obtain control of us.
Limitations on stockholder action without a meeting and the ability of stockholders to call a meeting.	Our certificate of incorporation does not allow stockholders to act by written consent. This requires that stockholders may act only at a duly called stockholders' meeting. In addition, under our certificate of incorporation special meetings of stockholders may not be called by the stockholders. Under our bylaws, special meetings of the stockholders may be called only by our chairman, the chief executive officer, or the Board of Directors.

Approval of Certain Corporate Actions.	Except as set forth in the following sentence, the stockholders may, by vote of a majority of the stock outstanding and entitled to vote thereon (or if there are two or more classes of stock entitled to vote as separate classes, then by vote of a majority of each such class of stock outstanding), (i) authorize any amendment to the certificate of incorporation, (ii) authorize the sale, lease, or exchange of all or substantially all of the corporation’s property and assets, and (iii) approve an agreement of merger or consolidation. Under our certificate of incorporation, the affirmative vote of the holders of at least 75% of the aggregate of the then outstanding shares of common stock (and of any series of preferred stock the terms of which provide for voting on the matter together with the common stock as a single class) shall be required to alter, amend, supplement or repeal, or to adopt any provision inconsistent with the purpose or intent of, Sections 4, 6.4(b), 12, 13 or 14 of Article Third of the certificate of incorporation, addressing capitalization of the Company, removal of directors without cause, the restrictions on stockholder action without a meeting and the ability of stockholders to call a meeting, as well as the 75% vote requirement itself.
Dividend Rights	Holders of outstanding shares of common stock are entitled to receive ratably any dividends declared by our Board of Directors, in its discretion, out of assets legally available, subject to preferences that may be applicable to any preferred stock outstanding at the time.
Liquidation Rights	Upon our voluntary or involuntary liquidation, dissolution or winding up, holders of our common stock are entitled to share ratably in all assets remaining after payment of liabilities and the liquidation preference of any then outstanding shares of preferred stock.
Preemption Rights	None.
Liability to Calls or Assessment	None.
Conversion Rights	None.
Redemption Rights	None.
Sinking Fund Provisions	None.

Effect of Issuance of Preferred Stock. The Board of Directors is authorized, subject to any limitations prescribed by law, without further stockholder approval, to issue from time to time up to an aggregate of 30,000,000 shares of preferred stock, $0.001 par value, in one or more series. None of such authorized shares are presently outstanding. Any series of preferred stock would have such number of shares, designations, preferences, voting powers, qualifications and special or relative rights or privileges as determined by the Board of Directors, which may include among others, dividend rights, voting rights, redemption and sinking fund provisions, liquidation preferences, conversion rights and preemptive rights.

The rights of the holders of common stock would be subject to the rights of holders of any preferred stock issued in the future. The effects of such issuance, among other things, could include dilution in the voting power of the common stock if the preferred stock has voting rights and the reduction or restriction of the rights of holders of common stock to receive a payment in the event of any liquidation, dissolution or winding up of the Company. The issuance of preferred stock may render more difficult or expensive or tend to discourage a merger, tender offer, or proxy contest, the assumption of control by a holder of a large block of our securities, or the removal of incumbent management.

Axcelis Technologies, Inc.
Named Executive Officer Base Compensation at March 02, 2020

This Exhibit discloses the current understandings with respect to base compensation between Axcelis Technologies, Inc. (the "Company") and each of:

- the Company's principal executive officer (Mary G. Puma),
- the Company's principal financial officer (Kevin J. Brewer), and
- the three most highly compensated other executive officers serving as executive officers at December 31, 2019.

These executive officers are referred to herein as "named executive officers" or "NEOs."

Mary G. Puma and the Company have entered into a written agreement addressing a minimum level of base salary due to the executive. The Company's Amended and Restated Employment Agreement with Ms. Puma ("Puma Employment Agreement") is listed as an Exhibit to this Form 10-K. Each of the other NEOs and the Company have entered into an Executive Separation Pay Agreement in which a termination without cause will entitle the executive to one year of separation pay. The form of Executive Separation Pay Agreement is listed as an Exhibit to this Form 10-K.

The Company maintains that all executive officers, other than Ms. Puma, are employees at will and that the Company has no obligation to continue their employment, other in cases where such obligation arises under the Change of Control Agreements described in our Proxy Statement and filed as an Exhibit to this Form 10-K.

Rate of Base Pay

In the course of the employment relationship with each NEO, the Company communicates to the named executive officer the amount of base salary approved by the Compensation Committee of the Board of Directors, which compensation is subject to change in the discretion of the Compensation Committee of the Board of Directors (provided Ms. Puma's employment agreement sets a minimum base pay amount). The following table sets forth the annual base salary as communicated to the named executive officers of the Company as in effect on March 2, 2020:

Named Executive Officer	Title	Rate of Annual Base Pay
Mary G. Puma	President and Chief Executive Officer	$ 615,000
Kevin J. Brewer	Executive VP and Chief Financial Officer	$ 392,000
John E. Aldeborgh	Executive VP, Global Customer Operations	$ 360,000
William Bintz	Executive VP, Engineering and Marketing	$ 330,000
Russell J. Low	Executive VP, Engineering	$ 330,000

Exhibit 10.12

Axcelis Technologies, Inc.
Non-Employee Director Cash Compensation at March 2, 2020

This Exhibit discloses the current understandings with respect to cash compensation between Axcelis Technologies, Inc. (the "Company") and each of its non-employee directors. Axcelis provides both cash retainers to its non-employee directors, as follows:

Annual Cash Retainers, paid quarterly in advance	
Board Member Retainer	$50,000
Independent Chairman Premium	$20,000
Committee Chair Retainers	
Audit Committee Chairman	$20,000
Compensation Committee Chairman	$15,000
Nominating and Governance Committee Chairman	$10,000
Technology and Product Development Committee Chairman	$10,000
Committee Member (not Chairman) Retainers	
Audit Committee Member	$10,000
Compensation Committee Member	$7,500
Nominating and Governance Committee Member	$5,000
Technology and Product Development Committee Member	$5,000

Non-employee directors also receive reimbursement of out-of-pocket expenses incurred in attending Board and committee meetings. Non-employee directors do not receive any Company-paid perquisites.

The Board of Directors may, from time to time, form committees in addition to the Audit, Compensation, Nominating and Governance and Technology and Product Development Committees and set compensation for service on such additional committees.

Axcelis Technologies, Inc.
Exhibit 21.1 to Form 10-K for the year ended December 31, 2019
Subsidiaries

The following is a list of all direct and indirect wholly-owned subsidiaries of Axcelis Technologies, Inc. as of the date hereof:

Domestic Subsidiaries

1. Axcelis Technologies (Israel) Inc., a Delaware corporation

European Subsidiaries

2. Axcelis Technologies GmbH (Germany)
3. Axcelis Technologies, Srl (Italy)
4. Axcelis Technologies, Sarl (France)

Asian Subsidiaries

5. Axcelis Technologies, KK (Japan)
6. Axcelis Technologies Limited (Korea)
7. Axcelis Technologies, Ltd. (Taiwan)
8. Axcelis Technologies Pte. Ltd. (Singapore)
9. Axcelis Technologies Semiconductor Trading (Shanghai) Co., Ltd. (Peoples Republic of China)

Exhibit 23.1

CONSENT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

We consent to the incorporation by reference in the following Registration Statements:

(1) Registration Statements (Form S-8 No. 333-181750, 333-188967, 333-196157, 333-204544, 333-211673, 333-218225 and 333-231634) pertaining to the 2012 Equity Incentive Plan of Axcelis Technologies, Inc.,

(2) Registration Statement (Form S-8 No. 333-49726) pertaining to the Employee Stock Purchase Plan of Axcelis Technologies, Inc.,

(3) Registration Statement (Form S-8 No. 333-49768) pertaining to the 2000 Stock Plan of Axcelis Technologies, Inc.,

(4) Registration Statement (Form S-8 No. 333-120356) pertaining to the 2000 Stock Plan and 2012 Equity Incentive Plan, and

(5) Registration Statement (Form S-3 No. 333-217192) pertaining to the registration of up to $75,000,000 of common stock, preferred stock, warrants, debt securities and units;

of our reports dated March 2, 2020, with respect to the consolidated financial statements and schedule of Axcelis Technologies, Inc. and the effectiveness of internal control over financial reporting of Axcelis Technologies, Inc. included in this Annual Report (Form 10-K) of Axcelis Technologies, Inc. for the year ended December 31, 2019.

/s/ Ernst & Young LLP

Boston, Massachusetts
March 2, 2020

CERTIFICATION
of the Principal Executive Officer
Pursuant to Rule 13a-14(a)/15d-14(a) (implementing Section 302 of the Sarbanes-Oxley Act)

I, Mary G. Puma, certify that:

1. I have reviewed this annual report on Form 10-K of Axcelis Technologies, Inc.;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the company as of, and for, the periods presented in this report;

4. The company's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the company and have:

   (a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the company, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

   (b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, 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;

   (c) Evaluated the effectiveness of the company's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

   (d) Disclosed in this report any change in the company's internal control over financial reporting that occurred during the company's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the company's internal control over financial reporting; and

5. The company's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the company's auditors and the audit committee of the company's board of directors (or persons performing the equivalent functions):

   (a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the company's ability to record, process, summarize and report financial information; and

   (b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 2, 2020	/s/ Mary G. Puma
	Mary G. Puma, *Chief Executive Officer and President*

CERTIFICATION
of the Principal Financial Officer
Pursuant to Rule 13a-14(a)/15d-14(a) (implementing Section 302 of the Sarbanes-Oxley Act)

I, Kevin J. Brewer, certify that:

1. I have reviewed this annual report on Form 10-K of Axcelis Technologies, Inc.;

2. Based on my knowledge, this report does not contain any untrue statement of a material fact or omit to state a material fact necessary to make the statements made, in light of the circumstances under which such statements were made, not misleading with respect to the period covered by this report;

3. Based on my knowledge, the financial statements, and other financial information included in this report, fairly present in all material respects the financial condition, results of operations and cash flows of the company as of, and for, the periods presented in this report;

4. The company's other certifying officer(s) and I are responsible for establishing and maintaining disclosure controls and procedures (as defined in Exchange Act Rules 13a-15(e) and 15d-15(e)) and internal control over financial reporting (as defined in Exchange Act Rules 13a-15(f) and 15d-15(f)) for the company and have:

   (a) Designed such disclosure controls and procedures, or caused such disclosure controls and procedures to be designed under our supervision, to ensure that material information relating to the company, including its consolidated subsidiaries, is made known to us by others within those entities, particularly during the period in which this report is being prepared;

   (b) Designed such internal control over financial reporting, or caused such internal control over financial reporting to be designed under our supervision, 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;

   (c) Evaluated the effectiveness of the company's disclosure controls and procedures and presented in this report our conclusions about the effectiveness of the disclosure controls and procedures, as of the end of the period covered by this report based on such evaluation; and

   (d) Disclosed in this report any change in the company's internal control over financial reporting that occurred during the company's most recent fiscal quarter (the registrant's fourth fiscal quarter in the case of an annual report) that has materially affected, or is reasonably likely to materially affect, the company's internal control over financial reporting; and

5. The company's other certifying officer(s) and I have disclosed, based on our most recent evaluation of internal control over financial reporting, to the company's auditors and the audit committee of the company's board of directors (or persons performing the equivalent functions):

   (a) All significant deficiencies and material weaknesses in the design or operation of internal control over financial reporting which are reasonably likely to adversely affect the company's ability to record, process, summarize and report financial information; and

   (b) Any fraud, whether or not material, that involves management or other employees who have a significant role in the registrant's internal control over financial reporting.

Date: March 2, 2020

/s/ Kevin J. Brewer
Kevin J. Brewer,
Executive Vice President and Chief Financial Officer

AXCELIS TECHNOLOGIES, INC.
Certification of the Chief Executive Officer
Pursuant to Section 1350 of Chapter 63 of title 18 of the United States Code

The undersigned Chief Executive Officer of Axcelis Technologies, Inc., a Delaware corporation, hereby certifies, for the purposes of Section 1350 of Chapter 63 of title 18 of the United States Code (as implemented by Section 906 of the Sarbanes-Oxley Act of 2002) as follows:

This Form 10-K annual report fully complies with the requirements of section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. 78m or 78o(d)) and the information contained herein fairly presents, in all material respects, the financial condition and results of operations of the Company.

IN WITNESS WHEREOF, the undersigned has executed this Certification as of March 2, 2020.

/s/ Mary G. Puma

Mary G. Puma
Chief Executive Officer and President of Axcelis Technologies, Inc.

AXCELIS TECHNOLOGIES, INC.
Certification of the Chief Financial Officer
Pursuant to Section 1350 of Chapter 63 of title 18 of the United States Code

The undersigned Chief Financial Officer of Axcelis Technologies, Inc., a Delaware corporation, hereby certifies, for the purposes of Section 1350 of Chapter 63 of title 18 of the United States Code (as implemented by Section 906 of the Sarbanes-Oxley Act of 2002) as follows:

This Form 10-K annual report fully complies with the requirements of section 13(a) or 15(d) of the Securities Exchange Act of 1934 (15 U.S.C. 78m or 78o(d)) and the information contained herein fairly presents, in all material respects, the financial condition and results of operations of the Company.

IN WITNESS WHEREOF, the undersigned has executed this Certification as of March 2, 2020.

/s/ Kevin J. Brewer
Kevin J. Brewer
Executive Vice President and Chief Financial Officer of Axcelis Technologies, Inc.