AXT INC
Form 10-K
February 27, 2017
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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, 2016
OR
TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the transition period from to

Commission file number: 000-24085

AXT, INC.

(Exact name of registrant as specified in its charter)

Delaware	94-3031310
(State or other jurisdiction of incorporation or organization)	(I.R.S. Employer Identification No.)
4281 Technology Drive, Fremont, California	94538
(Address of principal executive offices)	(Zip Code)

Registrant’s telephone number, including area code: (510) 438-4700

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

Title of each class	Name of each exchange on which registered
Common Stock, $0.001	The NASDAQ Stock Market LLC

par value
Securities registered pursuant to Section 12(g) of the Act:

None

Indicate by checkmark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act Yes No

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

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

Indicate by check mark whether the registrant has submitted electronically and posted on its corporate Web site, if any, every Interactive Data File required to be submitted and posted pursuant to Rule 405 of Regulation S-T (§ 232.405 of this chapter) during the preceding 12 months (or for such shorter period that the registrant was required to submit and post such files). Yes No

Indicate by checkmark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K (§ 229.405 of this chapter) is not contained herein, and will not be contained, to the best of registrant's knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K.

Indicate by checkmark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer or a smaller reporting company. See the definitions of "large accelerated filer," "accelerated filer," and "smaller reporting company" in Rule 12b-2 of the Act. (Check one):

reporting company)

Large accelerated filer Accelerated filer Non accelerated filer Smaller reporting company

(Do not check if a smaller reporting company)

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

The aggregate market value of the voting stock held by non-affiliates of the registrant, based upon the closing sale price of $3.19 for the common stock on June 30, 2016 as reported on the Nasdaq Global Select Market, was approximately $99,297,229. Shares of common stock held by each officer, director and by each person who owns 10% or more of the outstanding common stock have been excluded in that such persons may be deemed to be affiliates. This determination of affiliate status is not a conclusive determination for other purposes.

As of February 27, 2017, 33,031,479 shares, $0.001 par value, of the registrant's common stock were outstanding.

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PART I

This Annual Report (including the following section regarding Management's Discussion and Analysis of Financial Condition and Results of Operations) contains forward-looking statements within the meaning of Section 21E of the Securities Exchange Act of 1934, as amended. Statements relating to our expectations regarding results of operations, customer demand, customer qualifications of our products, our ability to expand our markets or increase sales, the development of new products, applications, enhancements or technologies, gross margins, expense levels, the impact of the adoption of certain accounting pronouncements, our investments in capital projects, our plan to relocate our China manufacturing operations, and our belief that we have adequate cash and investments to meet our needs over the next 12 months are forward-looking statements. Words such as "expects," "anticipates," "intends," "plans," "believes," "seeks," "estimates," "goals," "should," "continues," "would," "could" and similar expressions or variations of such words are intended to identify forward looking statements, but are not the exclusive means of identifying forward looking statements in this Annual Report. Additionally, statements concerning future matters such as our strategy, plans, industry trends and the impact of trends and economic cycles on our business are forward-looking statements. All forward-looking statements are based upon management's views as of the date of this Annual Report and are subject to risks and uncertainties that could cause actual results to differ materially from historical results or those anticipated in such forward-looking statements. Such risks and uncertainties include those set forth under the section entitled "Risk Factors" in Item 1A below, as well as those discussed elsewhere in this Annual Report, and identify important factors that could disrupt or injure our business or cause actual results to differ materially from those predicted in any such forward-looking statements.

These forward-looking statements are not guarantees of future performance. Readers are cautioned not to place undue reliance on these forward-looking statements, which speak only as of the date hereof. Readers are urged to carefully review and consider the various disclosures made in this report, which attempt to advise interested parties of the risks and factors that may affect our business, financial condition, results of operations and prospects. We undertake no obligation to revise or update any forward looking statements in order to reflect any development, event or circumstance that may arise after the date of this report.

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Item 1. Business

AXT, Inc. (“AXT”, “we,” “us,” and “our” refer to AXT, Inc. and its consolidated subsidiaries) is a worldwide developer and producer of high-performance compound and single element semiconductor substrates, also known as wafers. Our consolidated subsidiaries produce and sell certain raw materials some of which are used in our substrate manufacturing process and some of which are sold to other companies.

Our substrate wafers are used when a typical silicon substrate wafer cannot meet the conductive requirements of a chip. The dominant substrates used in producing semiconductor chips and other electronic circuits are made from silicon. However, certain chips may become too hot or perform their function too slowly if silicon is used as the base material. In addition, optoelectronic applications, such as LED lighting and chip-based lasers, do not use silicon substrates because they require a wave form frequency that cannot be achieved using silicon. Alternative or specialty materials are used to replace silicon as the preferred base in these situations. Our wafers provide such alternative or specialty materials. We have two product lines: specialty material substrates and raw materials. Our compound substrates combine indium with phosphorous (indium phosphide: InP) or gallium with arsenic (gallium arsenide: GaAs). Our single element substrates are made from germanium (Ge).

Our raw materials include both raw gallium and purified gallium. We use purified gallium in producing our GaAs substrates and sell both raw gallium and purified gallium in the open market to other companies for use in magnetic materials, high temperature thermometers and growing single crystal ingots including gallium arsenide, gallium nitride, gallium antimonide, gallium phosphide and other materials and alloys. We also produce pyrolytic boron nitride (pBN) crucibles used in the high temperature (typically in the range 500 C to 1,500 C) growth process of single crystal ingots and epitaxial layer growth in MBE (Molecular Beam Epitaxy) reactors. We use these pBN crucibles in our own ingot growth processes and also sell them in the open market to other companies. Our substrate product group generated 81%, 75% and 72% of our revenue and our raw materials product group generated 19%, 25% and 28% for 2016, 2015 and 2014, respectively.

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The following chart shows our substrate group and their materials, diameters and illustrative applications and shows our raw materials group primary products and illustrative uses and applications.

Products Substrate Group	Substrate Diameter	Sample of Applications
Indium Phosphide (InP)	2”, 3”, 4”	• Fiber optic lasers and detectors • Passive Optical Networks (PONs) • Data center connectivity using light/lasers • Silicon photonics • Photonic ICs (PICs) • High efficiency terrestrial solar cells (CPV) • RF amplifier and switching (military wireless and potential 5G) • Lasers • Infrared LED motion control • Infrared thermal imaging
Gallium Arsenide (GaAs - semi-insulating)	1”, 2”, 3”, 4”, 5”, 6”	• Power amplifiers for wireless devices • Direct broadcast television • High-performance transistors • Satellite communications • High efficiency solar cells for drones
Gallium Arsenide (GaAs - semi-conducting)	1”, 2”, 3”, 4”, 6”	• 3-D sensing using VCSELs • Data center communication using VCSELs • High brightness light emitting diodes (LEDs) • Lasers • Near-infrared sensors • Printer head lasers and LEDs • Laser machining, cutting and drilling • Optical couplers • Night vision goggles
Germanium (Ge)	2”, 4”, 6”	• Satellite and terrestrial solar cells • Optical sensors and detectors • Concentrated photo voltaic (CPV) cells for satellites • Multi-junction solar cells for satellites • Infrared detectors
Raw Materials Group		
4N raw gallium		• Magnetic materials • High temperature thermometers • Low melting point alloys • Optical glass • Infrared detectors
6N+ purified gallium		• Key material in single crystal ingots such as: - Gallium Arsenide (GaAs) - Gallium Nitride (GaN) - Gallium Antimonide (GaSb) - Gallium Phosphide (GaP)
Boron trioxide (B2O3)		• Encapsulant in the ingot growth of III-V compound semiconductors

Gallium-Magnesium alloy	• Used for the synthesis of organo-gallium compounds in epitaxial growth on semiconductor wafers
pyrolytic boron nitride (pBN) crucibles	• Used when growing single-crystal compound semiconductor ingots • Used when growing epitaxial layers in MBE reactors

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We manufacture all of our products in the People's Republic of China (PRC or China), which generally has favorable costs for facilities and labor compared with comparable facilities in the United States, Europe or Japan. Our supply chain includes partial ownership of 10 companies in China (subsidiaries/joint ventures). We believe this supply chain arrangement provides us with pricing advantages, reliable supply, market trend visibility and better sourcing lead-times for key raw materials central to manufacturing our substrates. Our subsidiaries and joint venture companies produce materials, including pure raw gallium (4N Ga), high purity gallium (6N Ga), arsenic, germanium, germanium dioxide, pyrolytic boron nitride (pBN) crucibles and boron oxide (B2O3). Our ownership and the ownership held by our consolidated subsidiaries in these entities range from 83% to 20%. We have board representation in all 10 of these companies. We consolidate the companies in which we have either a controlling financial interest, or majority financial interest combined with the ability to exercise substantive control over the operation or financial decisions made by the subsidiary. We use the equity method to account for companies in which we have smaller financial interest and have the ability to exercise significant influence, but not control, over the subsidiary. We purchase portions of the materials produced by these joint venture companies for our own use and sell the remainder of their production to third parties.

The Beijing city government has announced that it will expand its offices into the area where our manufacturing facility is located and we believe the Beijing city government intends to relocate thousands of government employees. The Beijing city government desires to upgrade this area and has applied pressure on manufacturing companies that use restricted materials to relocate, including us. It is our understanding that a master development plan of the area where our manufacturing facility is located has not yet been formally approved by the China central government and the timeline for relocating our gallium arsenide wafer production operations at our current site has not yet been determined by the China central government. We are advised that the China central government intends to be the final authority in this matter and is committed to having a master plan that is reasonable and orderly. We believe the China central government will undertake a comprehensive review of the master development plan, which will add time to the process. We are working with the government and are forming a plan to identify a new manufacturing site, acquire land use rights for such site, construct a facility and move our gallium arsenide production line. We intend to complete this relocation by the end of 2018 or the first half of 2019.

The Beijing city government's economic development bureau has requested that we consider maintaining our indium phosphide production operations at our current site, along with our China headquarters and research and development ("R&D") center. We believe we will still relocate our gallium arsenide and germanium production, but we may avoid moving indium phosphide production if we elect to remain at our current site. Over time it may be more efficient to consolidate all production at one site.

In light of our discussion with the Beijing city government, we believe we may be able to relocate the portion of our production facilities that we agree to relocate smoothly and safely and in a reasonable manner, without a material disruption of supply to our customers. The anticipated relocation of all or part of our operations will require us to develop and execute an orderly relocation plan. A failure to properly execute a relocation plan could result in disruption to our production and have a material adverse impact on our revenue and our results of operations and financial condition.

To date, we have not completed a land use rights purchase of our new manufacturing site. We do not yet have construction bids or third party estimates for the relocation costs or construction costs of our future manufacturing facility, but we currently believe the land use rights purchase amount, relocation costs and facility construction costs will be in the range of $25 million to $35 million, but could be substantially more expensive. Further, we believe that we may recover some of these costs by monetizing the vacated property at our current site in Beijing. We currently believe the soonest we could monetize the vacated property is the year 2020.

We were incorporated in California in December 1986 and reincorporated in Delaware in May 1998. The Company went public in 1998. We changed our name from American Xtal Technology, Inc. to AXT, Inc. in July 2000. Our principal corporate office is located at 4281 Technology Drive, Fremont, California 94538, and our telephone number at this address is (510) 438-4700. We have approximately 25 employees in our Fremont facility and approximately 661 employees in our Beijing facility.

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Industry Background

Certain electronic and opto-electronic applications have performance requirements that exceed the capabilities of conventional silicon substrates, also known as wafers, and often require high-performance compound, i.e. a mixture of two materials, or single element substrates. Examples of higher performance non-silicon based substrates include GaAs, InP, gallium nitride (GaN), silicon carbide (SiC) and Ge. One of the earliest broadly used alternative substrates was GaAs and GaAs substrates were the earliest substrates we produced.

Semi-insulating GaAs is used to create various high speed microwave components, including power amplifier chips in cell phones, satellite communications and broadcast television. Semi-conducting GaAs substrates are used to create opto-electronic products, including high brightness light emitting diodes (HBLEDs) that are often used to backlight wireless handsets and liquid crystal display (LCD) TVs and also used for automotive panels, signage, display and lighting applications. A possible new application for semi-conducting GaAs is 3-D sensing using VCSELs (vertical cavity surface emitting lasers), an array of lasers on a single chip that could be used in cell phones and other devices. InP is a high performance semiconductor substrate used in broadband and fiber optic applications and data center connectivity. In recent years InP demand has increased. Ge substrates are used in applications such as solar cells for space and terrestrial photovoltaic applications.

The AXT Advantages

We believe that we benefit from the following advantages:

- Key leadership in InP technology and revenue growth. We have invested in InP research and development for a number of years and have developed a strong base of proprietary technology that we continue to expand. There are significant barriers to entry in the InP substrate market and currently there are only three leading providers, including AXT. Further, we believe that this market will continue to expand and grow and we have been adding capacity to take advantage of this expansion.
- Key provider of low defect density GaAs which can be used to make 3-D sensing chips. The potential deployment of 3-D sensing in cell phones and other devices requires GaAs substrates with low etch pit density (EPD) (i.e., low defect densities.) The requirement of low EPD is a barrier to entry and we believe there are a limited number of potential substrate providers that can meet this requirement, which includes AXT.
- Proprietary process technology drives manufacturing. In our industry, the single crystal growth process and the wafer manufacturing process incorporate proprietary process technology. We have a substantial body of proprietary process technology and this creates a barrier to entry as evidenced by the small number of suppliers of InP wafers or GaAs low EPD wafers.
- Low-cost manufacturing operation in China. Since 2004, we have manufactured all of our products in China, which generally has favorable costs for facilities and labor compared to costs of comparable facilities and labor in the United States, Japan or Europe. As of December 31, 2016, approximately 969 of our 994 employees (including employees at both our Beijing facility as well as our consolidated joint venture companies) are located in China. Our primary competitors have their major manufacturing operations in Germany or Japan. Our presence in China also enables us to closely manage our raw materials supply chain.
- We are experienced at adding capacity quickly to take advantage of growing and changing market trends. In recent years we have quickly added capacity for InP substrates, enabling us to grow that business. We believe that expansion is less difficult in China than in Japan or Germany where our major competitors are located. High volume emerging market applications may require rapid expansion and we believe we are well-positioned to respond to increased demand.

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- We are the only compound semiconductor substrate supplier to have a position in raw materials. We have partial ownership in 10 companies in China that form an integral part of our supply chain. We believe our subsidiaries and joint venture companies in China provide us with more reliable supply and shorter lead-times for the raw materials central to our final manufactured products compared to third party providers. We believe that this dedicated supply chain will enable us to meet increases in demand from our customers by providing an increased volume of raw materials quickly, efficiently and cost effectively.
- Our diverse product offering results in a broader range of customers and applications. We offer a diverse range of products, which enables us to have a broad range of customers. For the year ended December 31, 2016, no customer accounted for over 10% of revenue and our five largest customers accounted for 35% of our revenue. We believe this diversity enabled us to recover quickly when a large portion of GaAs chips was replaced with silicon-on-insulator (SOI) chips in mobile phone switches, beginning in 2011. Further, this diversity gives us a greater opportunity to expand our business into new applications and markets and benefit from growth in demand for substrates given our pre-established market positions in a broad range of product applications.
- Enhanced revenue diversity through the sale of special materials. Because our strategy allows our subsidiaries to also sell raw materials in the open market to third parties, approximately one fifth of our total sales are from non-substrate products, providing further diversity in our customer base and business model.
- Business model unique among current competitors. We believe we are the only publicly traded company producing InP, GaAs and Ge substrates. Our direct competitors are either privately owned companies or divisions within large publicly traded companies. We believe the combination of access to U.S. capital markets, U.S.-based product quality standards, but China-based manufacturing and a unique strategy for the supply of many of the raw materials we need is an attractive business model to our customers who desire longevity and stability in their supply chain as well as competitive prices.
- Strong cash position with $54 million in cash and investments. As a pure play substrate provider, we have a strong cash position that enables us to make strategic investments in facilities, capacity, equipment, technology and resources. Our competitive focus and flexibility is supported by the staying power that this cash ensures.

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Strategy

Our goal is to become the leading worldwide supplier of high-performance compound and single element semiconductor substrates. Key elements of our strategy include:

Position AXT to benefit from emerging InP markets. As cloud-based data centers combine integrated circuits and InP-based lasers to transfer data through light, we believe there could be increased demand for InP substrates, which could complement our sales in the fiber-to-home and office markets. We believe there are also other possible applications for InP substrates in the future, which could include 5G cell phones and driverless cars.

Add InP capacity and continue InP R&D. We are adding manufacturing capacity for InP to support our expected growth for this product line. Substrate products often have long product life cycles and we believe the InP product life cycle could be similar to the GaAs product life cycle that has run for over 10 years. In addition to adding manufacturing capacity, we are continuing to invest in InP crystal growth technology and wafer processing technology. For example, we are developing six-inch diameter ingots and improving the relative flatness of the wafer surface to improve performance.

Position AXT to benefit from 3-D sensing applications. We are continuing to develop semi-conducting GaAs six-inch diameter wafers with low etch pitch density. The GaAs substrate requirements for 3-D sensing application include very low defect densities. As 3-D sensing applications develop, we believe there is a potential for high volumes for this product.

Secure the option to increase GaAs capacity when we finalize the relocation plans for manufacturing this substrate. The planned relocation of our GaAs manufacturing lines presents a strategic opportunity to ensure at the new site the ability to increase capacity in the future should market demands justify such capacity expansion and we intend to review the capacity expansion requirements as we proceed.

Offer diverse products, including custom products. We believe AXT has a reputation in the market place for providing a broad range of products, including custom products. We plan to further promote this brand image as a way to differentiate ourselves in the market place. Some competitors provide only gallium arsenide substrates. We provide gallium arsenide and also indium phosphide and germanium substrates. Some competitors provide only six inch diameter wafers. Our wafers range from one inch to up to six inches in diameter. We also produce substrates with customer defined specifications which may range from thickness or smoothness and may include adding special additional elements such as iron or sulfur. We believe product diversity can mitigate some of the impact of down cycles in our market because we are not dependent on a single product or application for revenue.

Many customers not just a few large customers. We seek to expand our customer base and avoid dependence on just a few large customers. We believe our diverse product offering has resulted in a diverse customer base. For the year ended December 31, 2016, no customer accounted for over 10% of revenue and our five largest customers accounted for 35% of our revenue. We believe customer diversity provides a measure of stability in troubled market conditions. Customer diversification may also enable us to achieve a higher average selling price by reducing our dependence on larger customers with pricing power.

Sustain manufacturing efficiencies. We seek to continue to leverage our China-based manufacturing advantage by increasing efficiencies in our manufacturing methods, systems and processes. Our strategy is to combine the benefits of U.S.-based quality control and access to U.S. capital markets with our China-based manufacturing operations.

Increase productivity and seek profitability in our 10 subsidiaries/joint venture companies. The supply and demand equation for specialty materials can be complex and volatile. Over the years, we have established or invested in 10

companies that are an integral part of our supply chain. We will continue to provide strategic support to these companies and they, in turn, will continue to be the backbone of our supply chain. We plan to work closely with these companies to increase their productivity and achieve profitability as they continue to support AXT's supply chain.

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Materials of the future. The specialty materials substrate market is dynamic and subject to continued changes and cycles. We plan to use our deep knowledge and experience in specialty materials and wafer substrates to seek new applications for existing substrates in our portfolio and explore additional materials that may be synergistic with our knowledge base, customer needs and manufacturing lines.

Technology

Wafers serve as a cornerstone in semiconductor device fabrication, on which integrated circuits and optical devices are fabricated. Wafers are sliced up from semiconducting ingots that are grown in a cylindrical form. The diameter and length of an ingot will vary depending on the type of material and the growth process used. An ingot may be either single-crystalline (also referred to as single element) or multi-crystalline (also referred to as compound elements). Single-crystalline wafers typically have better material parameters. Depending on physical properties of the materials in a wafer, the performance of devices and circuits can be remarkably different.

AXT uses its proprietary vertical gradient freeze (VGF) technique for growing single crystal Indium Phosphide (InP), Gallium Arsenide (GaAs) and Germanium (Ge) ingots. After growing the crystalline ingot, the ingot is then sawed into individual substrates or wafers. Before specialty material wafers can be used, a thin layer of structured chemicals is grown on the surface of the substrate. This is called an epitaxial layer. We sell the majority of our substrates to companies that specialize in applying the epitaxial layer. The wafers are then used to produce state-of-the-art electronic and opto-electronic devices and circuit applications.

InP and GaAs semiconducting compounds are formed combining elements from Groups III and V in the periodic table of elements, whereas Ge is a Group IV elemental semiconductor. Each of these materials has unique properties that determine the best device and/or circuit applications. As a result of their special high electron mobility combined with their direct ban-gap properties, both InP and GaAs wafers have enjoyed dominant roles in the production of light emitting diodes (LEDs), solid-state lasers and power amplifiers for mobile phones, to name a few applications. Ge wafers, on the other hand, have played a key role in the manufacturing of special solar cells known as triple junction solar cells (TJSCs) for space and terrestrial power generation.

With the recent evolution in several applications, InP lasers are projected to play a dominant role in the optoelectronics arena, e.g. silicon photonics (where InP lasers are a key component) and autonomous cars (where special wavelength InP-based lasers are used for object sensing and collision avoidance). Crystal growth process technology frequently contains steps and procedures that are considered proprietary secrets held by the producer, often including methods to control the temperature within the crucible. InP crystal growth relies on extreme pressure within the crucible. As such it requires not only temperature control methodologies, but also pressure control and stabilization process methodologies, many of which AXT considers proprietary trade secrets. It is this combination of variables and the required methods to control them that create a barrier to entry.

We believe our long-term investment in InP research and development has resulted in a substantive body of proprietary knowledge. In addition, to complement our VGF proprietary growth expertise, in July 2015, we acquired the InP proprietary process technology and crystal growth equipment from Crystacomm, Inc., thus adding the capability of growing polycrystalline and large diameter single crystal InP ingots using the Crystacomm proprietary Liquid Encapsulated Czochralski (LEC) technology. Crystacomm has a long history in development and experimentation in InP and this acquisition transfers that proprietary technology to us. A number of Crystacomm’s proprietary methods can also be used in our VGF processes.

After growing the crystalline ingot, the material is then sawed into individual substrates or wafers. We have continued to invest in wafer processing technology covering each step in the process from sawing to edge smoothing to final cleaning and we believe we have technology and trade secrets addressing the scope of wafer processing. One

focus in our recent development programs has been on automation. In this regard, in October 2015, we announced that we had acquired Hitachi Metals' automated equipment and a license covering the use of the proprietary equipment and Hitachi Metals' proprietary wafer processing technology. A significant body of knowledge in this portfolio is considered proprietary trade secrets. We have combined the acquired proprietary processing technology and equipment with our existing wafer processing capabilities to better serve our existing and future customer base.

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Ideally, all the atoms in a wafer or substrate are arrayed in a specific periodic order. However, sensitivities in the ingot growth process will cause some atoms to be improperly aligned and these are referred to as dislocations. The aggregate number of dislocations in a wafer is referred to as the dislocation density. Dislocation densities can be seen as a group of tiny marks or pits under a microscope by etching the wafer with acid and each wafer has an “etch pit density” (“EPD”). Certain micro devices, such as the array used for 3-D sensing, require wafers with very low EPD. AXT considers the process technology we use to achieve low EPD as proprietary process technology and we are one of only a few substrate manufacturing companies that can produce low EPD wafers.

Products

We have two product lines: specialty material substrates and raw materials. We design, develop, manufacture and distribute high-performance semiconductor substrates, also known as wafers. Through our subsidiaries in our supply chain, we also sell certain raw materials. InP is a high-performance semiconductor substrate used in fiber optic lasers and detectors, passive optical networks (PONs), data center connectivity, silicon photonics, photonic ICs (PICs), terrestrial solar cell (CPV), lasers, RF amplifiers (military wireless), infrared motion control and infrared thermal imaging. We make semi-insulating GaAs substrates used in making semiconductor chips in applications such as power amplifiers for wireless devices, high-performance transistors and high efficiency solar cells for drones. Our semi-conducting GaAs substrates are used to create opto-electronic products, which include High Brightness LEDs that are often used to backlight wireless handsets and LCD TVs and for automotive, signage, display and lighting applications. Our semi-conducting GaAs substrates could be used to create opto-electronic products for 3-D sensing using VCSELs. Ge substrates are used in emerging applications, such as triple junction solar cells for space and terrestrial photovoltaic applications and for optical applications.

Substrates. We currently sell compound substrates manufactured from InP and GaAs, as well as single element substrates manufactured from Ge. We supply InP substrates in two-, three and four-inch diameters, and Ge substrates in two-, four- and six-inch diameters. We supply both semi-insulating and semiconducting GaAs substrates in one-, two-, three , four-, five- and six-inch diameters. Many of our customers require customized specifications, such as special levels of iron or sulfur dopants or a special wafer thickness.

Raw Materials. Our consolidated subsidiaries produce and sell certain raw materials, some of which are used in our substrate manufacturing process and some of which are sold to other companies. Our raw materials include both raw gallium and purified gallium. We use purified gallium to produce our GaAs substrates and sell both raw gallium and purified gallium in the open market to other companies for use in magnetic materials, high temperature thermometers and single crystal ingots, including gallium arsenide, gallium nitride, gallium antimonide, gallium phosphide and other materials and alloys. We also produce pyrolytic boron nitride (pBN) crucibles used in the high temperature (typically in the range 500 C to 1,500 C) growth process of single crystal ingots and epitaxial layer growth in MBE reactors. We use these pBN crucibles in our own ingot growth processes and also sell them in the open market to other companies.

We promote our product diversity as a way to differentiate ourselves in the market place. Some competitors provide only gallium arsenide substrates. We provide gallium arsenide and also indium phosphide and germanium substrates. Some competitors provide only six-inch wafers. Our wafers range from one inch to up to six inches in diameter. We also produce substrates with customer defined specifications, which may range in thickness or smoothness and may include adding special additional materials, such as iron or sulfur. In addition to our wafers or substrates, we also generate revenue from our consolidated subsidiaries that sell raw materials. Product diversity can mitigate some of the down cycles in our market because we are not dependent on a single product or application for revenue.

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Customers

Before specialty material wafers can be processed in a typical wafer manufacturing facility that constructs the electronic circuit on a chip, a thin layer of structured chemicals is grown on the surface of the substrate. This is called an epitaxial layer. We sell our substrates to companies that apply the epitaxial layer, who then in turn sell the modified wafers to the wafer fabs, chip design companies, LED manufacturers and others. Some customers do both the epitaxial layer and wafer fabrication.

Epitaxial layer companies that form our customer base are located in Asia, the United States and Europe. We also sell our products to universities and other research organizations who use specialty materials for experimentation in various aspects of semiconducting and semi insulating applications. Our customers that purchase raw materials are located in Asia, the United States and Europe.

We have at times sold a significant portion of our products in any particular period to a limited number of customers. However, no customer represented more than 10% of our revenue for the year ended December 31, 2016. One customer, IQE Group, represented more than 12% of our revenue for the year ended December 31, 2015 while there was no customer who represented more than 10% of our revenue for the year ended December 31, 2014. Our top five customers, although not the same five customers for each period, represented 35%, 40% and 34% of our revenue for the years ended December 31, 2016, 2015 and 2014, respectively.

There were four third-party customers for the raw materials products from our consolidated subsidiaries that each accounted for over 10% of the revenue from raw materials sales for the year ended December 31, 2016 and three customers for the raw materials products from our consolidated subsidiaries that accounted for over 10% of the revenue from raw materials sales for each of the years ended December 31, 2015 and December 31, 2014. Our subsidiaries and joint ventures are a key strategic benefit for us as they further diversify our sources of revenue.

Manufacturing, Raw Materials and Supplies

We manufacture all of our wafers/substrate products at our facilities in Beijing, China. We believe this location generally has favorable costs for facilities and labor compared to the United States or compared to the location of some of our competitors in Japan and Germany.

We use a two-stage wafer manufacturing process. The first stage deploys our VGF technology for the crystal growth of single element or compound element ingots in diameters currently ranging from one inch to six inches. The growth process occurs in high temperature furnaces built using our proprietary designs. Growing the crystalline elements into cylindrical ingots can take four to twelve days, depending on the diameter and length of the ingot produced. The crystal growth stage utilizes AXT proprietary process technology. The second stage includes slicing or sawing the ingot into wafers or substrates, then processing each substrate to strict specifications, including grinding to reduce the thickness and then polishing, beveling the edges and cleaning each substrate. Many of the wafer processing steps use chemical baths and properly cleaning the wafer is a critical process. The wafer processing stage utilizes AXT proprietary process technology.

Wafers from each ingot will include some material that does not meet specifications or quality standards. Defects may occur as a result of inherent factors in the materials used in the crystalline growth process. They may also result from variances in the manufacturing process. We have many steps in our line that are partially or fully automated but other manufacturing steps are performed manually. We intend to increase the level of automation. In 2015, we purchased wafer processing equipment from Hitachi Metals that we expect will increase automation in our production line and, therefore, reduce variability and defects. In addition, we secured a manufacturing license from Hitachi Metals. This license includes detailed work instructions for using the equipment purchased and allows us to apply the proprietary

wafer processing technology at any step and on any form of equipment in our line. We deployed the equipment handling four-inch wafers in our InP line in 2016. The equipment for six-inch wafers will be deployed after we finalize the plan to relocate our gallium arsenide line. Due to potential defects, yield is a key factor in our manufacturing cost. Other key elements are the initial cost of the raw material elements, manufacturing equipment, factory loading, facilities and labor. Our Beijing facilities are approximately 300,000 square feet and, as of December 31, 2016, we employed approximately

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661 employees at this site. In 2015, we also acquired equipment from an InP company, Crystacomm, that specializes in the LEC method of crystal growth.

We have 10 partially owned subsidiaries and joint ventures companies in China that form the backbone of our supply chain model. These companies provide us with reliable supply, market trend visibility, and shorter lead-times for raw materials central to our manufactured products, including gallium, gallium alloys, indium phosphide poly-crystal, arsenic, germanium, germanium dioxide, high purity arsenic, pBN and boron oxide. We believe that these subsidiaries and joint ventures have been and will continue to be advantageous in allowing us to procure materials to support our planned growth. In addition, we purchase supply parts, components and raw materials from several other domestic and international suppliers. We depend on a single or limited number of suppliers for certain critical materials used in the production of our substrates, such as quartz tubing, arsenic and polishing solutions. We generally purchase our materials through standard purchase orders and not pursuant to long-term supply contracts.

Sales and Marketing

We sell our substrate products directly to customers through our direct salesforce in the United States and China and through independent sales representatives and distributors in Europe and other areas of Asia. Our direct salesforce is knowledgeable in the use of compound and single element substrates. Specialty material wafers are scientifically complicated. Our application engineers must work closely with customers during all stages of the substrate manufacturing process, from developing the precise composition of the substrate through manufacturing and processing the substrate to the customer's specifications. We believe that maintaining a close relationship with customers and providing them with engineering support improves customer satisfaction and provides us with a competitive advantage in selling. Six of our employees who frequently work with customers have PhDs in physics or material science.

International Sales. International sales are a substantial part of our business. Sales to customers outside North America (primarily the United States) accounted for approximately 90%, 87% and 88% of our revenue during 2016, 2015 and 2014, respectively. The primary markets for sales of our substrate products outside of the United States are to customers located in Asia and Western Europe.

Our subsidiaries and joint venture companies sell specialty raw materials including 4N, 5N, 6N, 7N and 8N gallium, boron oxide, germanium, arsenic, germanium dioxide, pyrolytic boron nitride crucibles used in crystal growth and parts for MBE. These subsidiaries and joint ventures have their own separate sales forces and sell directly to their own customers in addition to selling raw materials to us.

Research and Development

To maintain and improve our competitive position, we focus our research and development efforts on designing new proprietary processes and products, improving the performance of existing products, increasing yields and reducing manufacturing costs. We also conduct research and development focusing on larger diameter wafers and, in our history, we have consistently developed new products based on larger wafer diameters. Crystal growth of specialty earth materials becomes significantly more difficult as the ingot diameter increases because a consistent temperature, and in the case of InP, consistent control of pressure, must be applied over a larger surface area. In 2015, we acquired certain proprietary InP crystal growth technology and equipment from Crystacomm. There are several proprietary process steps that we believe we can adopt at AXT. We originally planned to deploy the equipment at our Fremont facility, but have subsequently decided to deploy it in China due to restrictions on the use of red phosphorus placed upon our Fremont facility by various government agencies.

Certain micro devices, such as the array used for 3-D sensing, require GaAs wafers with very low etch pit density. In anticipation of a growth in demand for low EPD six-inch wafers, we have focused our development efforts on increasing our yield of such wafers.

Our current substrate research and development activities focus on continued development and enhancement of GaAs, InP and Ge substrates, including improved yield, enhanced surface and electrical characteristics and uniformity, greater substrate strength and increased crystal length. In 2015, we acquired a significant number of proprietary wafer

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processing stations from Hitachi Metals. The Hitachi Metals purchase includes a license covering the use of the proprietary equipment and Hitachi Metals' proprietary wafer processing technology. A particular focus of the equipment and process technology is on cleaning the wafers. It is important to remove any residual cleaning agents from each wafer to ensure that the epitaxial growth process is not encumbered by residual chemicals on the wafer.

Our three consolidated subsidiaries conduct research and development, focusing on gallium alloys, gallium refinement and pyrolytic boron nitride crucibles used in high temperature crystal growth.

We have assembled a multi disciplinary team of skilled scientists, engineers and technicians to meet our research and development objectives. Research and development expenses were $5.9 million in 2016, compared with $5.7 million in 2015 and $4.1 million in 2014.

Competition

The semiconductor substrate industry is characterized by narrow technological boundaries, price erosion and generally intense competition. Certain substrates, such as low quality substrates for LED lighting, compete almost entirely on price. Other products, such as InP and low EPD GaAs wafers, have fewer competitors and quality is a key competitive factor in addition to price. We face actual and potential competition from a number of established companies who have the advantage of greater name recognition and more established relationships in the industry. In some cases, competitors have substantially greater financial, technical and marketing resources. They may utilize these advantages to expand their product offerings more quickly, adapt to new or emerging technologies and changes in customer requirements more quickly, and devote greater resources to the marketing and sale of their products. A critical element is technical support extended to the customer or prospective customer and we attempt to counter possible advantages of name recognition or size with superior technical support through the use of employees who have PhDs in physics or material science.

We believe that the primary competitive factors in the markets in which our substrate products compete are:

- quality;
- price;
- customer technical support;
- performance;
- meeting customer specifications; and
- manufacturing capacity.

Our ability to compete in target markets also depends on factors such as:

- the timing and success of the development and introduction of new products, including larger diameter wafers, and product features by us and our competitors;
- the availability of adequate sources of raw materials;
- protection of our proprietary methods, systems and process;
- protection of our products by effective use of intellectual property laws; and
- general economic conditions, which impact end markets using substrates.

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The large majority of our customers specialize in epitaxial growth, a chemical layer grown on top of our wafers. Typically our customer or prospective customer has at least two substrate suppliers qualified for the production of its products. Qualified suppliers must meet industry standard specifications for quality, on-time delivery and customer support. Once a substrate supplier has qualified with a customer, price, consistent quality and current and future product delivery lead times become the most important competitive factors. A supplier that cannot meet a customer's current lead times or that a customer perceives will not be able to meet future demand and provide consistent quality can lose market share. Our primary competition in the market for compound and single element semiconductor substrates includes Freiberger Compound Materials ("Freiberger"), Japan Energy ("JX"), Umicore, Sumitomo Electric Industries ("Sumitomo") and China Crystal Technology Corp., ("CCTC"). We believe that at least two of our competitors are shipping high volumes of GaAs substrates manufactured using a technique similar to our VGF technique. In addition, we also face competition from semiconductor device manufacturers that produce substrates for their own use, and for other companies, such as Skyworks and Qorvo, that are actively exploring alternative materials and marketing semiconductor devices using these alternative materials. For example, silicon-on-insulator (SOI) technology, a silicon wafer technology that produces satisfactory devices at lower cost, has been proven in the market. From 2011 to 2013, SOI technology displaced GaAs chips in key sectors, primarily the radio frequency (RF) switching function in cell phones.

Because of our vertically integrated, sophisticated supply chain through our subsidiaries and joint venture companies, we believe we are the only compound semiconductor substrate supplier to offer a full suite of raw materials. We believe this gives us a unique competitive advantage because we have greater control and stability over the needed materials. Further, we believe we have some advantage in manufacturing costs. In the event of a significant increase in demand we believe our raw materials supply chain strategy and our ability to rapidly increase capacity can provide us some advantage.

Intellectual Property

Our success and the competitive position of our VGF technology depend on our ability to maintain our proprietary process technology secrets and other intellectual property protections. We rely on a combination of patents, trademark and trade secret laws, non-disclosure agreements and other intellectual property protection methods to protect our proprietary technology. We believe that, due to the rapid pace of technological innovation in the markets for our products, our ability to establish and maintain a position of technology leadership depends as much on the skills of our research and development personnel as upon the legal protections afforded our existing technologies. To protect our trade secrets, we take certain measures to ensure their secrecy, such as executing non-disclosure agreements with our employees, customers and suppliers. However, reliance on trade secrets is only an effective business practice insofar as trade secrets remain undisclosed and a proprietary product or process is not reverse engineered or independently developed.

To date, we have been issued 42 patents that relate to our VGF products and processes, eight in the United States, five in Japan, 24 in China, one in Canada, one in Korea, and two in Taiwan. A U.S. patent has a protected life of 20 years from the filing date. Our patents have expiration dates ranging from 2017 to 2032. In some cases we may consider filing divisional, continuation or continuation-in-part of the existing patents for additional claims. We have two U.S. patent applications pending and 15 foreign patent applications pending, including three in Europe, nine in China, two in Japan and one in the Patent Cooperation Treaty stage. Furthermore, in aggregate, our three consolidated joint venture companies have been issued 46 patents in China, including five issued patents for JiYa, 19 issued patents for JinMei and 22 issued patents for BoYu.

We entered into a technology license and royalty agreement with Sumitomo, effective December 3, 2010, with a term of eight years, terminating December 31, 2018. We and our related companies are granted a worldwide, nonexclusive, royalty bearing, irrevocable license to certain patents for the term of the agreement.

In the normal course of business, we periodically receive and make inquiries regarding possible patent infringement. In dealing with such inquiries, it may become necessary or useful for us to obtain or grant licenses or other rights. However, there can be no assurance that such licenses or rights will be available to us on commercially reasonable terms. If we are not able to resolve or settle claims, obtain necessary licenses on commercially reasonable

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terms and/or successfully prosecute or defend our position, our business, financial condition and results of operations could be materially and adversely affected.

Environmental Regulations

We are subject to federal, state and local environmental laws and regulations, including laws in China as well as in the United States and Europe. These laws, rules and regulations govern the use, storage, discharge and disposal of hazardous chemicals during manufacturing, research and development and sales demonstrations. We maintain a number of environmental, health and safety programs that are primarily preventive in nature. As part of these programs, we regularly monitor ongoing compliance. If we fail to comply with applicable regulations, we could be subject to substantial liability for personal injury, clean-up efforts, fines and suspension or cessation of our operations. The regulatory landscape shifts and changes in China as that country attempts to address its environmental pollution. Because we manufacture all of our products in China, we are subject to an evolving regulatory administration requiring changes in our equipment and securing new permits.

Employees

As of December 31, 2016, we had approximately 686 employees, which consisted of approximately 25 employees in our headquarters in Fremont and approximately 661 employees in Beijing. In addition, our three consolidated subsidiaries had, in total, approximately 308 employees. In aggregate, we and our subsidiaries had 994 employees, of whom 813 were principally engaged in manufacturing, 115 in sales and administration, and 66 in research and development. Of these 994 employees, 25 were located in the United States and 969 in China.

Most workers in China are represented by unions. As of December 31, 2016, 853 employees in China including employees of our subsidiaries were represented by unions, but we have never experienced a work stoppage. We consider our relations with our employees to be good.

Geographical Information

Please see Note 15 of our Notes to Consolidated Financial Statements for information regarding our foreign operations, and see “Risks related to international aspects of our business” under Item 1A. Risk Factors for further information on risks attendant to our foreign operations and dependence.

Available Information

Our principal executive offices are located at 4281 Technology Drive, Fremont, CA 94538, and our main telephone number at this address is (510) 438-4700. Our Internet website address is www.axt.com. Our website address is given solely for informational purposes; we do not intend, by this reference, that our website should be deemed to be part of this Annual Report on Form 10-K or to incorporate the information available at our Internet address into this Annual Report on Form 10 K.

We file electronically with the Securities and Exchange Commission, or SEC, our annual reports on Form 10-K, quarterly reports on Form 10-Q, current reports on Form 8-K, and amendments to those reports filed or furnished pursuant to Section 13(a) or 15(d) of the Securities Exchange Act of 1934, as amended. We make these reports available free of charge through our Internet website as soon as reasonably practicable after we have electronically filed such material with the SEC. These reports can also be obtained from the SEC’s Internet website at www.sec.gov or at the SEC's Public Reference Room at 100 F Street, N.E., Washington, D.C. 20549. The public may obtain information on the operation of the Public Reference Room by calling the SEC at 1-800-SEC-0330.

Item 1A. Risk Factors

For ease of reference, we have divided these risks and uncertainties into the following general categories:

I. Risks related to our general business;

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II. Risks related to international aspects of our business;
III. Risks related to our financial results and capital structure;
IV. Risks related to our intellectual property; and
V. Risks related to compliance, environmental regulations and other legal matters.

I. Risks Related to Our General Business

Silicon substrates (wafers) are significantly lower in cost compared to substrates made from specialty materials and new silicon-based technologies could allow silicon based substrates to replace specialty material based substrates for certain applications.

Historically silicon wafers or substrates are less expensive than specialty material substrates, such as those that we produce. Electronic circuit designers will generally consider silicon first and only turn to alternative materials if silicon cannot provide the required functionality in terms of power consumption, speed or other specifications. Beginning in 2011, certain applications that had previously used GaAs substrates adopted a new silicon-based technology called Silicon On Insulator, or SOI. SOI technology uses a silicon-insulator-silicon layered substrate in place of conventional silicon substrates in semiconductor manufacturing. SOI substrates cost less than GaAs substrates and, although their performance is not as robust as GaAs substrates in terms of power consumption, heat generation and speed, they became acceptable in mobile phone and other applications that were previously dominated by GaAs substrates. The adoption of SOI resulted in decreased GaAs wafer demand, and decreased revenue. If SOI or similar technologies gain more widespread market acceptance, or are used in more applications, our sales of specialty material based substrates could be reduced and our business and operating results could be significantly and adversely affected.

Our gross margin has fluctuated historically and may decline due to several factors.

Our gross profit margin has fluctuated from period to period as a result of shifts in the cost of raw materials, shifts in product mix, the introduction of new products, decreases in average selling prices for products, utilization of our manufacturing capacity and our ability to reduce product costs. These fluctuations are expected to continue in the future.

We do not control the prices at which our subsidiaries and other joint venture companies sell their raw materials products to third parties. However, because we consolidate the results of three of these companies with our own, any reduction in their gross margins could have a significant, adverse impact on our overall gross margins. One or more of our companies has in the past sold, and may in the future sell, raw materials at significantly reduced prices in order to gain volume sales or sales to new customers. In addition, in the three months ended December 31, 2015, the market price of gallium dropped below our per unit inventory cost and we incurred an inventory write down under the lower of cost or market accounting rules. In such events, our gross margin may be adversely impacted. In addition, one of our consolidated subsidiaries has in the past been subject to capacity constraints requiring it to source product from other third party suppliers in order to meet customer demand, resulting in decreased gross margin and adversely impacting our consolidated gross margin. This joint venture may in the future continue to experience such capacity restraints, causing our gross margin, and consequently our operating results, to be adversely impacted.

Underutilizing our manufacturing facilities may result in declines in our gross margins.

An important factor in our success is the extent to which we are able to utilize the available capacity in our manufacturing facilities. A number of factors and circumstances may reduce utilization rates, including periods of industry overcapacity, low levels of customer orders, operating inefficiencies, mechanical failures and disruption of operations due to expansion, power interruptions, fire, flood or other natural disasters or calamities. Because many portions of our manufacturing costs are relatively fixed, high utilization rates are critical to our gross margins and operating results. If we fail to achieve acceptable manufacturing volumes or experience product shipment delays, our

results of operations will be negatively affected. During periods of decreased demand, we have underutilized our manufacturing lines. If we are unable to improve utilization levels at our facilities during periods of decreased demand

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and correctly manage capacity, the fixed expense levels will have an adverse effect on our business, financial condition and results of operations. Our gross profit margins have fluctuated from period to period, and these fluctuations are expected to continue in the future. Our gross profit margin has fluctuated from 17.1% for the quarter ended December 31, 2015 to 37.1% in the quarter ended December 31, 2016.

In 2013, we concluded that incoming orders were insufficient and that we were significantly underutilizing our factory capacity. As a result, in February 2014, we announced a restructuring plan with respect to our wholly-owned subsidiary, Beijing Tongmei Xtal Technology Co, Ltd., or Tongmei, in order to better align manufacturing capacity with demand. Under the restructuring plan, we posted a charge of approximately $907,000 in the first quarter of 2014.

If we receive fewer customer orders than forecasted or if our customers delay or cancel orders, we may not be able to reduce our manufacturing costs in the short-term and our gross margins would be negatively affected. In addition, lead times required by our customers are shrinking, which reduces our ability to forecast orders and properly balance our capacity utilization.

If we have low product yields, the shipment of our products may be delayed and our product cost and operating results may be adversely impacted.

A critical factor in our product cost is yield. Our products are manufactured using complex technologies, and the number of usable substrates we produce can fluctuate as a result of many factors, including:

- poor control of furnace temperature and pressure;
- impurities in the materials used;
- contamination of the manufacturing environment;
- quality control and inconsistency in quality levels;
- lack of automation and inconsistent processing requiring manual manufacturing steps;
- substrate breakage during the manufacturing process; and
- equipment failure, power outages or variations in the manufacturing process.

A current example where yield is of special concern is for our six-inch semi-conducting gallium arsenide substrates, which can be used for manufacturing opto-electronic devices in cell phones, enabling 3-D sensing. This application requires very low defect densities, also called etch pit densities, and our yields will be lower than the yields achieved for the same substrate when it will be used in other applications. If we are unable to achieve the targeted quantity of low defect density substrates, then our manufacturing costs would increase and our gross margins would be negatively impacted.

In addition, we may modify our process to meet a customer specification, but this can impact our yields. If our yields decrease, our revenue could decline if we are unable to produce products to our customers' requirements. At the same time, our manufacturing costs could remain fixed, or could increase. Lower yields negatively impact our gross margin. We have experienced product shipment delays and difficulties in achieving acceptable yields on both new and older products, and delays and poor yields have adversely affected our operating results. We may experience similar problems in the future and we cannot predict when they may occur or their duration or severity.

If our manufacturing processes result in defects in our products making them unfit for use by our customers, our products would be rejected, resulting in compensation costs paid to our customers, and possible disqualification. This could lead to revenue loss and market share loss.

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Risks exist in relocating our gallium arsenide manufacturing operations.

The Chinese government has imposed, and may impose in the future, manufacturing restrictions and regulations that require us to move part of our manufacturing operations to a location outside of the Beijing area or temporarily cease or limit manufacturing. If we are required to relocate our manufacturing operations or cease or limit our manufacturing, such restrictions would materially and adversely impact our results of operations and our financial condition.

The Beijing city government has announced that it will expand its offices into the area where our manufacturing facility is located and we believe the Beijing city government intends to relocate thousands of government employees. The Beijing city government desires to upgrade this area and has applied pressure on manufacturing companies that use restricted materials to relocate, including us. It is our understanding that a master development plan of the area where our manufacturing facility is located has not yet been formally approved by the China central government and the timeline for relocating our gallium arsenide wafer production operations at our current site has not yet been determined by the China central government. We are working with the government and are forming a plan to identify a new manufacturing site, acquire land use rights for such a site, construct a facility and move our gallium arsenide production line. We intend to complete this relocation by the end of 2018 or the first half of 2019.

The anticipated relocation of all or part of our manufacturing operations will require us to develop and execute an orderly relocation plan. A failure to properly execute a relocation plan could result in disruption to our production and have a material adverse impact on our revenue and our results of operations and financial condition.

Once we complete the relocation of our gallium arsenide product line and commence manufacturing operations at our future manufacturing facility, we may be required to qualify our products with some of our customers. If we fail to meet the product qualification requirements of a customer, we may lose sales to that customer and may not have the opportunity to sell future products to that customer. Our reputation may also be damaged. Any loss of sales could have a material adverse effect on our revenue and our results of operations and financial condition.

We expect many of the key employees who are employed at our current manufacturing facility to relocate to the new manufacturing site and assist with the transition. There can be no assurances that the key employees will relocate or that we will be able to hire qualified employees for our new manufacturing facility. A loss of key employees and our inability to hire qualified employees for our new manufacturing facility could disrupt our production, which could materially and adversely impact our results of operations and our financial condition.

To date, we have not completed a land use rights purchase of our new manufacturing site. We do not yet have construction bids or third party estimates for the relocation costs of construction costs of our future manufacturing facility, but we currently believe the land use rights purchase amount, relocation costs and facility construction costs

will be in the range of $25 million to $35 million, but could be substantially more expensive. There can be no assurances that we may recover some or all of these costs by monetizing the vacated property at our current site in Beijing.

The Chinese government has in the past imposed temporary restrictions on manufacturing facilities, such as the restrictions imposed on polluting factories for the 2008 Olympics and the 2014 Asian Pacific Economic Cooperation event. These restrictions included a shut-down of the transportation of materials and power plants to reduce air pollution. To reduce air pollution in Beijing, the Chinese government has sometimes limited the construction of new, or expansion of existing, facilities by manufacturing companies in the Beijing area. If the government applied similar restrictions to us, then such restrictions could have an adverse impact on our results of operations and our financial condition. Our ability to supply current or new orders could be significantly impacted. Customers could then be required to purchase products from our competitors, causing our competitors to take market share from us.

In addition, from time to time, the Chinese government issues new regulations, which may require additional actions on our part to comply. On February 27, 2015, the China State Administration of Work Safety updated its list of hazardous substances. The previous list, which was published in 2002, did not restrict the materials that we use in our wafers. The new list added gallium arsenide. As a result of the newly published list, we were instructed to obtain a permit to continue to manufacture our gallium arsenide substrate wafers. The Beijing municipal authority accepted our

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permit application in May 2015, but has not issued to us the requisite permit while we continue to make preparations in good faith to eventually relocate our gallium arsenide production. If our application is denied in the future then our gallium arsenide production could be disrupted, which could materially and adversely impact our results of operations and our financial condition.

Demand for our products may decrease if demand for the end-user applications decrease or if manufacturers downstream in our supply chain experience difficulty manufacturing, marketing or selling their products.

Our products are used as components in electronic and opto-electronic products. Accordingly, demand for our products is subject to the demand for end-user applications which utilize our products, as well as factors affecting the ability of the manufacturers downstream in our supply chain to introduce and market their products successfully, including:

- the competition such manufacturers face in their particular industries;
- the technical, manufacturing, sales, marketing and management capabilities of such manufacturers;
- the financial and other resources of such manufacturers; and
- the inability of such manufacturers to sell their products if they infringe third party intellectual property rights.

If demand for the end-user applications for which our products are used decreases, or if manufacturers downstream in our supply chain are unable to develop, market and sell their products, demand for our products will decrease. For example, in the second half of 2016 manufacturers producing and selling passive optical network devices known as EPONs and GPONs experienced a slowdown in demand resulting in surplus inventory on hand. This resulted in a slowdown of sales of our InP substrates. We expect similar cycles of strong demand and then lower demand will occur for various InP, GaAs or Ge substrates in the future.

Our revenue, gross margins and profitability can be hurt if the average sales price of the various raw materials in our partially owned companies decreases.

Although the companies in our vertically integrated supply chain have historically made a positive contribution to our financial performance, the average selling prices for many of the raw materials produced have continued to decline and have had a negative impact on our recent financial performance. In particular, the selling prices for 4N gallium and for germanium have been driven down by oversupply and, in the second half of 2015 and in 2016, negatively impacted our financial results. In 2016 the seven companies accounted for under the equity method of accounting contributed a loss of $2.0 million to our financial statements. Low selling prices for raw materials continue and will have a detrimental impact on our 2017 financial performance. There can be no assurance that the oversupply will be corrected by the market. Further, in the fourth quarter of 2015, one of our consolidated subsidiaries incurred a lower of cost or market inventory write down, which negatively impacted our consolidated gross margin. If the pricing environment remains stressed by oversupply and our joint venture companies cannot reduce their production cost, then the reduced average selling prices of the raw materials produced by our joint venture companies will have a continuing adverse impact on our revenue, gross margins and net profit.

Problems incurred in our 10 partially owned joint venture companies or investment partners could result in a material adverse impact on our financial condition or results of operations.

We have invested in 10 subsidiaries and joint venture companies in China that produce materials including 99.99% pure gallium (4N Ga), high purity gallium (7N Ga), arsenic, germanium, germanium dioxide, pyrolytic boron nitride

(pBN) crucibles and boron oxide (B2O3). We purchase a portion of the materials produced by these companies for our use and they sell the remainder of their production to third parties. Our ownership and the ownership held by our consolidated subsidiaries in these entities ranges from 20% to 83%. We consolidate the companies in which we have a majority or controlling financial interest and employ equity accounting for the companies in which we have a smaller

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ownership interest. Several of these companies occupy space within larger facilities owned and/or operated by one of the other venture partners. Several of these venture partners are engaged in other manufacturing activities at or near the same facility. In some facilities, we share access to certain functions, including water, hazardous waste treatment or air quality treatment. If any of our joint venture partners in any of these ventures experiences problems with its operations, disruptions of our joint venture operations could result, having a material adverse effect on the financial condition and results of operation of our joint venture companies, and correspondingly on our financial condition or results of operations. For example, since gallium is a by-product of aluminum, our raw gallium joint venture in China, which is housed in and receives services from an affiliated aluminum plant, could generate lower production of gallium as a result of reduced services provided by the aluminum plant. Accordingly, in order to meet customer supply obligations, our supply chain may have to source materials from another independent third party supplier, resulting in reduced gross margin.

In addition, if any of our joint ventures or venture partners with which our joint ventures share facilities is deemed to have violated applicable laws, rules or regulations governing the use, storage, discharge or disposal of hazardous chemicals during manufacturing, research and development or sales demonstrations, the operations of our joint ventures could be adversely affected and we could be subject to substantial liability for clean-up efforts, personal injury and fines or suspension or cessation of our joint venture operations as a result of the actions of the joint ventures or other venture partners. Employees working for our joint ventures or any of the other venture partners could bring litigation against us as a result of actions taken at the joint venture or venture partner facilities, even though we are not directly controlling the operations, including actions for exposure to chemicals or other hazardous materials at the facilities of our joint ventures or the facilities of any venture partner that are shared by our joint ventures. While we would expect to defend ourselves vigorously in any litigation that is brought against us, litigation is inherently uncertain and it is possible that our business, financial condition, results of operations or cash flows could be affected. Even if we are not deemed responsible for the actions of the joint ventures or venture partners, litigation could be costly, time consuming to defend and divert management attention; in addition, if we are deemed to be the most financially viable of the partners, plaintiffs may decide to pursue us for damages.

Since all of our partially owned companies reside in China, their activities could subject us to a number of risks associated with conducting operations internationally, including:

- difficulties in managing geographically disparate operations;
- difficulties in enforcing agreements through non-U.S. legal systems;
- unexpected changes in regulatory requirements that may limit our ability to manufacture, export the products of our joint venture companies, sell into particular jurisdictions or impose multiple conflicting tax laws and regulations;
- political and economic instability, civil unrest or war;
- terrorist activities that impact international commerce;
- difficulties in protecting our intellectual property rights, particularly in countries where the laws and practices do not protect proprietary rights to as great an extent as do the laws and practices of the United States;
- changing laws and policies affecting economic liberalization, foreign investment, currency convertibility or exchange rates, taxation or employment; and
- nationalization of foreign owned assets, including intellectual property.

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Intense competition in the markets for our products could prevent us from increasing revenue and sustaining profitability.

The markets for our products are intensely competitive. We face competition for our substrate products from other manufacturers of substrates, such as Freiberger, JX, Umicore, Sumitomo and CCTC and from companies, such as Qorvo and Skyworks, that are actively considering alternative materials to GaAs and marketing semiconductor devices using these alternative materials. We believe that at least two of our major competitors are shipping high volumes of GaAs substrates manufactured using a technique similar to our VGF technology. Other competitors may develop and begin using similar technology. Sumitomo and JX also compete with us in the InP market. If we are unable to compete effectively, our revenue may not increase and we may not achieve profitability. We face many competitors that have a number of significant advantages over us, including:

· greater name recognition and market share in the business;
· more manufacturing experience;
· extensive intellectual property; and
· significantly greater financial, technical and marketing resources.

Our competitors could develop new or enhanced products that are more effective than our products.

The level and intensity of competition has increased over the past years and we expect competition to continue to increase in the future. Competitive pressures have resulted in reductions in the prices of our products, and continued or increased competition could reduce our market share, require us to further reduce the prices of our products, affect our ability to recover costs and result in reduced gross margins.

In addition, new competitors have and may continue to emerge, such as a crystal growing company established by a former employee in China that is supplying semi-conducting GaAs wafers to the LED market. Competition from sources such as this could increase, particularly if these competitors are able to obtain large capital investments.

The average selling prices of our substrates may decline over relatively short periods, which may reduce our revenue and gross margins.

Since the market for our products is characterized by declining average selling prices resulting from various factors, such as increased competition, overcapacity, the introduction of new products and decreased sales of products incorporating our products, the average selling prices for our products may decline over relatively short time periods. We have in the past experienced, and in the future may experience, substantial period-to-period fluctuations in operating results due to declining average selling prices. For example, for the year ended December 31, 2016, we experienced an average selling price decline of our substrate selling prices of approximately 5% to 10%, depending on the substrate product. It is possible that the pace of the decline of average selling prices could accelerate beyond these levels for certain products in a commoditizing market. We anticipate that average selling prices will decrease in the future in response to the unstable demand environment, product introductions by competitors or us, or by other factors, including pricing pressures from significant customers. When our average selling prices decline, our revenue and gross profit decline, unless we are able to sell more products or reduce the cost to manufacture our products. We generally attempt to combat an average selling price decline by improving yields and manufacturing efficiencies and working to reduce the costs of our raw materials and of manufacturing our products. We have in the past, and may in the future, experience declining selling prices, which could negatively impact our revenues, gross profits and financial results. We, therefore, need to sell our current products in increasing volumes to offset any decline in their average selling prices, and introduce new products, which we may not be able to do, or do on a timely basis.

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We may be unable to reduce the cost of our products sufficiently to enable us to compete with others. Our cost reduction efforts may not allow us to keep pace with competitive pricing pressures and could adversely affect our margins. In order to remain competitive, we must continually work to reduce the cost of manufacturing our products. There is no assurance that any changes effected by us will result in sufficient cost reductions to allow us to reduce the price of our products to remain competitive or improve our gross margins.

Defects in our products could diminish demand for our products.

Our products are complex and may contain defects, including defects resulting from impurities inherent in our raw materials or inconsistencies in our manufacturing processes. We have experienced quality control problems with some of our products, which caused customers to return products to us, reduce orders for our products, or both. If we experience quality control problems, or experience these or other problems in new products, customers may cancel or reduce orders or purchase products from our competitors and we may be unable to maintain or increase sales to our customers and sales of our products could decline. Defects in our products could cause us to incur higher manufacturing costs and suffer product returns and additional service expenses, all of which could adversely impact our operating results. If new products developed by us contain defects when released, our customers may be dissatisfied and we may suffer negative publicity or customer claims against us, lose sales or experience delays in market acceptance of our new products.

Our substrate products have a long qualification cycle that makes it difficult to forecast our revenue.

New customers typically place orders with us for our substrate products three months to a year or more after our initial contact with them. In addition, existing customers may be slow to purchase our products. The sale of our products is subject to our customers' lengthy internal evaluation and approval processes. During this time, we may incur substantial expenses and expend sales, marketing and management efforts while the customers evaluate our products. These expenditures may not result in sales of our products. If we do not achieve anticipated sales in a period as expected, we may experience an unplanned shortfall in our revenue. As a result, our operating results would be adversely affected. In addition, if we fail to meet the product qualification requirements of the customer, we may not have another opportunity to sell that product to that customer for many months or even years. In the current competitive climate, the average qualification and sales cycle for our products has lengthened even further and is expected to continue to make it difficult for us to forecast our future sales accurately. We anticipate that sales of any future substrate products will also have lengthy qualification periods and will, therefore, be subject to risks substantially similar to those inherent in the lengthy sales cycles of our current substrate products.

The loss of one or more of our key substrate customers would significantly hurt our operating results.

Although no customer represented more than 10% of our revenue for year ended December 31, 2016, we did have one customer over 10% of revenue for the year ended December 31, 2015 and if we were to lose a major customer it would negatively impact our revenue. Most of our customers are not obligated to purchase a specified quantity of our products or to provide us with binding forecasts of product purchases. In addition, our customers may reduce, delay or cancel orders at any time without any significant penalty. In the past, we have experienced a slowdown in bookings, significant push-outs and cancellation of orders from customers. If we lose a major customer or if a customer cancels, reduces or delays orders, or reduces the prices paid for our products, our revenue would decline. In addition, customers that have accounted for significant revenue in the past may not continue to generate revenue for us in any future period. Any loss of customers or any delay in scheduled shipments of our products could cause revenue to fall below our expectations and the expectations of market analysts or investors, causing our stock price to decline.

The cyclical nature of the semiconductor industry may limit our ability to maintain or increase net sales and operating results during industry downturns.

The semiconductor industry is highly cyclical and periodically experiences significant economic downturns characterized by diminished product demand, resulting in production overcapacity and excess inventory in the markets we serve. A downturn can result in lower unit volumes and rapid erosion of average selling prices. The semiconductor industry has experienced significant downturns, often in connection with, or in anticipation of, maturing product cycles

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of both semiconductor companies' and their customers' products or a decline in general economic conditions. This may adversely affect our results of operations and the value of our business.

Our continuing business depends in significant part upon manufacturers of electronic and opto-electronic compound semiconductor devices, as well as the current and anticipated market demand for these devices and products using these devices. As a supplier to the compound semiconductor industry, we are subject to the business cycles that characterize the industry. The timing, length and volatility of these cycles are difficult to predict. The compound semiconductor industry has historically been cyclical due to sudden changes in demand, the amount of manufacturing capacity and changes in the technology employed in compound semiconductors. The rate of changes in demand, including end demand, is high, and the effect of these changes upon us occurs quickly, exacerbating the volatility of these cycles. These changes have affected the timing and amounts of customers' purchases and investments in new technology. These industry cycles create pressure on our revenue, gross margin and net income.

Our industry has in the past experienced periods of oversupply and that has resulted in significantly reduced prices for compound semiconductor devices and components, including our products, both as a result of general economic changes and overcapacity. When this occurs our operating results and financial condition are adversely affected. Oversupply causes greater price competition and can cause our revenue, gross margins and net income to decline. During periods of weak demand, customers typically reduce purchases, delay delivery of products and/or cancel orders of component parts such as our products. Further order cancellations, reductions in order size or delays in orders could occur and would materially adversely affect our business and results of operations. Actions to reduce our costs may be insufficient to align our structure with prevailing business conditions. We may be required to undertake additional cost-cutting measures, and may be unable to invest in marketing, research and development and engineering at the levels we believe are necessary to maintain our competitive position. Our failure to make these investments could seriously harm our business.

We base our planned operating expenses in part on our expectations of future revenue, and a significant portion of our expense is relatively fixed. If revenue for a particular quarter is lower than we expect, we likely will be unable to proportionately reduce our operating expenses for that quarter, which would harm our operating results.

If we do not successfully develop new products to respond to rapidly changing customer requirements, our ability to generate revenue, obtain new customers, and retain existing customers may suffer.

Our success depends on our ability to offer new products, including larger diameter substrates, low defect density substrates and product features that incorporate leading technology and respond to technological advances. In addition, our new products must meet customer needs and compete effectively on quality, price and performance. The markets for our products are characterized by rapid technological change, changing customer needs and evolving industry standards. If our competitors introduce products employing new technologies or performance characteristics, our existing products could become obsolete and unmarketable. During the past few years, we have seen our competitors selling more substrates manufactured using a crystal growth technology similar to ours, which has eroded our technological differentiation.

The development of new products can be a highly complex process, and we may experience delays in developing and introducing new products. Any significant delay could cause us to fail to timely introduce and gain market acceptance of new products. Further, the costs involved in researching, developing and engineering new products could be greater than anticipated. If we fail to offer new products or product enhancements or fail to achieve higher quality products, we may not generate sufficient revenue to offset our development costs and other expenses or meet our customers' requirements.

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We have made and may continue to make strategic investments in raw materials suppliers, which may not be successful and may result in the loss of all or part of our investment.

We have made investments through our subsidiaries and joint ventures in ten raw material suppliers in China, which provide us with opportunities to gain supplies of key raw materials that are important to our substrate business. These affiliates each have a market beyond that provided by us. We do not have influence over all of these companies and in some we have made only a strategic, minority investment. We may not be successful in achieving the financial, technological or commercial advantage upon which any given investment is premised, and we could end up losing all or part of our investment. As a result of sharp declines in the average selling price of materials in 2016 the seven companies accounted for under the equity method of accounting contributed a loss of $2.0 million to our financial statements.

We purchase critical raw materials and parts for our equipment from single or limited sources, and could lose sales if these sources fail to fill our needs.

We depend on a limited number of suppliers for certain raw materials, components and equipment used in manufacturing our products, including key materials such as quartz tubing, and polishing solutions. Although several of these raw materials are purchased from suppliers in which we hold an ownership interest, we generally purchase these materials through standard purchase orders and not pursuant to long-term supply contracts, and no supplier guarantees supply of raw materials or equipment to us. If we lose any of our key suppliers, our manufacturing efforts could be significantly hampered and we could be prevented from timely producing and delivering products to our customers. Prior to investing in our subsidiaries and joint ventures, we sometimes experienced delays obtaining critical raw materials and spare parts, including gallium and we could experience such delays again in the future due to shortages of materials or for other reasons and may be unable to obtain an adequate supply of materials. Delays in receiving equipment or materials could result in higher materials costs and cause us to delay or reduce production of our products. If we have to delay or reduce production, we could fail to meet customer delivery schedules and our revenue and operating results could suffer.

We may not be able to identify additional complementary joint ventures.

Although we are not currently pursuing additional joint ventures, in the future we might invest in additional joint ventures in order to remain competitive in our marketplace and ensure a supply of critical raw materials. However, we may not be able to identify additional complementary joint venture opportunities or, even once opportunities are identified, we may not be able to reach agreement on the terms of the venture with the other venture partners. Additional joint ventures could cause us to incur contingent liabilities or other expenses, any of which could adversely affect our financial condition and operating results.

If any of our facilities are damaged by occurrences such as fire, explosion, power outage or natural disaster, we might not be able to manufacture our products.

The ongoing operation of our manufacturing and production facilities in China is critical to our ability to meet demand for our products. If we are not able to use all or a significant portion of our facilities for prolonged periods for any reason, we would not be able to manufacture products for our customers. For example, a fire or explosion caused by our use of combustible chemicals and high temperatures during our manufacturing processes or power interruption caused by severe weather conditions could render some or all of our facilities inoperable for an indefinite period of time. Actions outside of our control, such as earthquakes or other natural disasters, could also damage our facilities, rendering them inoperable. If we are unable to operate our facilities and manufacture our products, we would lose customers and revenue and our business would be harmed.

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If China places restrictions on freight and transportation routes and on port of entry and departure this could result in shipping delays or increased costs for shipping.

In August 2015, there was an explosion at the Port of Tianjin, China. As a result of this incident the government placed restrictions on importing certain materials and on freight routes used to transport these materials. We experienced some modest disruption from these restrictions. If the government were to place additional restrictions on the transportation of materials, then our ability to transport our raw materials or products could be limited and result in bottlenecks at shipping ports, affecting our ability to deliver products to our customers. During periods of such restrictions, we may increase our stock of critical materials (such as arsenic, gallium, and other chemicals) for use during the period that these restrictions are likely to last, which will increase our use of cash and increase our inventory level. Any of these restrictions could materially and adversely impact our results of operations and our financial condition.

The financial condition of our customers may affect their ability to pay amounts owed to us.

Many of our customers may be undercapitalized and cope with cash flow issues. Because of competitive market conditions, we frequently allow our customers extended payment terms when shipping products to them. Subsequent to our shipping a product, some customers have been unable to make payments when due, reducing our cash balances and causing us to incur charges to allow for a possibility that some accounts might not be paid. Customers may also be forced to file for bankruptcy. If our customers do not pay their accounts we will be required to incur charges that would reduce our earnings.

We depend on the continuing efforts of our senior management team and other key personnel. If we lose members of our senior management team or other key personnel, or are unable to successfully recruit and train qualified personnel, our ability to manufacture and sell our products could be harmed.

Our future success depends on the continuing services of members of our senior management team and other key personnel. Our industry is characterized by high demand and intense competition for talent, and the turnover rate can be high. We compete for qualified management and other personnel with other specialty material companies and semiconductor companies. Our employees could leave our company with little or no prior notice and would be free to work for a competitor. If one or more of our senior executives or other key personnel were unable or unwilling to continue in their present positions, we may not be able to replace them easily or at all, and other senior management may be required to divert attention from other aspects of the business. The loss of any of these individuals or our ability to attract or retain qualified personnel could adversely affect our business.

Our results of operations may suffer if we do not effectively manage our inventory.

We must manage our inventory of raw materials, work-in-process and finished goods effectively to meet changing customer requirements, while keeping inventory costs down and improving gross margins. Although we seek to maintain sufficient inventory levels of certain materials to guard against interruptions in supply and to meet our near term needs, and have to date been able to obtain sufficient supplies of materials in a timely manner, in the future, we may experience shortages of certain key materials. Some of our products and supplies have in the past and may in the future become obsolete while in inventory due to changing customer specifications, or become excess inventory due to decreased demand for our products and an inability to sell the inventory within a foreseeable period. This would result in charges that reduce our gross profit and gross margin. Furthermore, if market prices drop below the prices at which we value inventory, we may need to take a charge for a reduction in inventory values in accordance with the lower of cost or market valuation rule. We have in the past had to take inventory valuation and impairment charges.

Any future unexpected changes in demand or increases in costs of production that cause us to take additional charges for un-saleable, obsolete or excess inventory, or to reduce inventory values, could adversely affect our results of operations.

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Financial market volatility and adverse changes in the domestic and global economic environment could have a significant adverse impact on our business, financial condition and operating results.

We are subject to the risks arising from adverse changes and uncertainty in domestic and global economies. Uncertain global economic and political conditions and low or negative growth in China, Europe and the United States, along with volatility in the financial markets, increasing national debt and fiscal concerns in various regions, pose challenges to our industry. Currently China's economy is slowing and this could impact our financial performance. Although we remain well-capitalized, the cost and availability of funds may be adversely affected by illiquid credit markets. Turbulence in U.S. and international markets and economies may adversely affect our liquidity, financial condition and profitability. Another severe or prolonged economic downturn could result in a variety of risks to our business, including:

- increased volatility in our stock price;
- increased volatility in foreign currency exchange rates;
- delays in, or curtailment of, purchasing decisions by our customers or potential customers either as a result of overall economic uncertainty or as a result of their inability to access the liquidity necessary to engage in purchasing initiatives;
- increased credit risk associated with our customers or potential customers, particularly those that may operate in industries most affected by the economic downturn; and
- impairment of our intangible or other assets.

In the past we experienced delays in customer purchasing decisions and disruptions in normal volume of customer orders that we believe were in part due to the uncertainties in the global economy and an adverse impact on consumer spending. During challenging and uncertain economic times and in tight credit markets, many customers delay or reduce technology purchases. Should similar events occur again, our business and operating results could be significantly and adversely affected.

Global economic and political conditions may have an impact on our business and financial condition in ways that we currently cannot predict.

Our operations and financial results depend on worldwide economic conditions and their impact on levels of business spending, which had deteriorated significantly in many countries and regions in previous years. Uncertainties in the financial and credit markets may cause our customers to postpone deliveries of ordered systems and placement of new orders and extended uncertainties may reduce future sales of our products and services. The revenue growth and profitability of our business depends on the overall demand for our substrates, and we are particularly dependent on the market conditions for the wireless, solid state illumination, fiber optics and telecommunications industries. Because the end users of our products are primarily large companies whose businesses fluctuate with general economic and business conditions, a softening of demand for products that use our substrates, caused by a weakening economy, may result in decreased revenue. Customers may find themselves facing excess inventory from earlier purchases, and may defer or reconsider purchasing products due to the downturn in their business and in the general economy. If market conditions deteriorate, we may experience increased collection times and greater write-offs, either of which could have a material adverse effect on our profitability and our cash flow.

Future tightening of credit markets and concerns regarding the availability of credit may make it more difficult for our customers to raise capital, whether debt or equity, to finance their purchases of capital equipment or of the products we sell. Delays in our customers' ability to obtain such financing, or the unavailability of such financing, would adversely affect our product sales and revenues and therefore harm our business and operating results. We cannot predict the timing, duration of or effect on our business of any future economic downturn or the timing or strength of any subsequent recovery.

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The effect of terrorist threats and actions on the general economy could decrease our revenue.

Developed countries such as the United States and China continue to be on alert for terrorist activity. The potential near- and long-term impact terrorist activities may have in regards to our suppliers, customers and markets for our products and the economy is uncertain. There may be embargos of ports or products, or destruction of shipments or our facilities, or attacks that affect our personnel. There may be other potentially adverse effects on our operating results due to significant events that we cannot foresee. Since we perform all of our manufacturing operations in China, terrorist activity or threats against U.S. owned enterprises are a particular concern to us.

II. Risks Related to International Aspects of Our Business

We derive a significant portion of our revenue from international sales, and our ability to sustain and increase our international sales involves significant risks.

Our revenue growth depends in part on the expansion of our international sales and operations. Typically over 80% of our revenue is from international sales. We expect that sales to customers outside the United States, particularly sales to customers in Japan, Taiwan and China, will continue to represent a significant portion of our revenue.

Currently, a significant percentage of our revenue is to customers headquartered in Asia. All of our manufacturing facilities and most of our suppliers are also located outside the United States. Managing our overseas operations presents challenges, including periodic regional economic downturns, trade balance issues, varying business conditions and demands, political instability, variations in enforcement of intellectual property and contract rights in different jurisdictions, differences in the ability to develop relationships with suppliers and other local businesses, changes in U.S. and international laws and regulations, including U.S. export restrictions, fluctuations in interest and currency exchange rates, the ability to provide sufficient levels of technical support in different locations, cultural differences and perceptions of U.S. companies, shipping delays and terrorist acts or acts of war, among other risks. Many of these challenges are present in China, which represents a large potential market for semiconductor devices. Global uncertainties with respect to: (i) economic growth rates in various countries; (ii) sustainability of demand for electronics products; (iii) capital spending by semiconductor manufacturers; (iv) price weakness for certain semiconductor devices; (v) changing and tightening environmental regulations and (vi) political instability in regions where we have operations may also affect our business, financial condition and results of operations.

Our dependence on international sales involves a number of risks, including:

- changes in tariffs, import restrictions, export restrictions, or other trade barriers;
- unexpected changes in regulatory requirements;
- longer periods to collect accounts receivable;
- changes in export license requirements;
- political and economic instability;
- unexpected changes in diplomatic and trade relationships; and
- foreign exchange rate fluctuations.

Our sales are denominated in U.S. dollars, except for sales to our Chinese customers which are denominated in Renminbi and our Japanese customers which are denominated in Japanese yen. Increases in the value of the U.S. dollar could increase the price of our products in non-U.S. markets and make our products more expensive than competitors' products in these markets.

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Denominating some sales in Japanese yen subjects us to fluctuations in the exchange rates between the U.S. dollar and the Japanese yen. For example, in the second half of 2014, the exchange rate of Japanese yen to U.S. dollar moved from 101.55 to 119.95 from June 30, 2014 to December 31, 2014. As a result, in 2014 we incurred foreign currency transaction exchange losses which are included in "other income (expense), net" on the consolidated statements of operations of $1.0 million. We incur transaction gains or losses resulting from the purchase and sale activities denominated in foreign currencies other than functional currencies at the respective consolidated entities. We accumulate translation gain or losses resulting from marking certain balance sheet assets and liabilities to the current market rate for those consolidated entities whose functional currencies are other than the reporting currency, which are recorded as component of "accumulated other comprehensive income (loss)" on the consolidated balance sheets. Although we have instituted a foreign currency hedging program, we still experience losses on foreign exchange from time to time.

The functional currency of our Chinese subsidiary and joint ventures is the local currency. If we do not effectively manage the risks associated with international sales, our revenue, cash flows and financial condition could be adversely affected.

Uncertainty regarding the United States' foreign policy under the new administration could disrupt our business.

We manufacture our substrates in China and, in 2016, approximately 90% of our sales are to customers located outside of the United States. Further, we have partial ownership of 10 companies in China as part of our supply chain. The United States' foreign policy under the new administration could create uncertainty and caution in the international business community, resulting in possible disruptions in manufacturing, import/export, trade tariffs, sales, investments or other business activity. Such disruptions could have an adverse impact on our financial performance.

Changes in tariffs, import or export restrictions, Chinese regulations or other trade barriers may reduce gross margins.

We may incur increases in costs due to changes in tariffs, import or export restrictions, or other trade barriers, unexpected changes in regulatory requirements, any of which could reduce our gross margins. For example, in July 2012, we received notice of retroactive value-added taxes (VATs) levied by the tax authorities in China, which applied for the period from July 1, 2011 to June 30, 2012. We expensed the retroactive VATs of approximately $1.3 million in the quarter ended June 30, 2012, which resulted in a decrease in our gross margins. These VATs will continue to negatively impact our gross margins for the future quarters. Given the relatively fluid regulatory environment in China, there could be additional tax or other regulatory changes in the future. Any such changes could directly and materially adversely impact our financial results and general business condition.

Our operating results depend in large part on continued customer acceptance of our substrate products manufactured in China and continued improvements in product quality.

We manufacture all of our products in China, and source most of our raw materials in China. We have in the past experienced quality problems with our China manufactured products. Our previous quality problems caused us to lose market share to our competitors, as some of our customers reduced their orders from us until our wafer surface quality was as good and as consistent as that offered by our competitors and instead allocated their requirements for compound semiconductor substrates to our competitors. If we are unable to continue to achieve customer qualifications for our products, or if we are unable to control product quality, customers may not increase purchases of

our products, our China facility will become underutilized, and we will be unable to achieve revenue growth.

Changes in China's political, social, regulatory or economic environments may affect our financial performance.

Our financial performance may be affected by changes in China's political, social, regulatory or economic environments. The role of the Chinese central and local governments in the Chinese economy is significant. Chinese policies toward economic liberalization, and laws and policies affecting technology companies, foreign investment, currency exchange rates, taxation structure and other matters could change, resulting in greater restrictions on our ability to do business and operate our manufacturing facilities in China. Any imposition of surcharges or any increase in Chinese tax rates or reduction or elimination of Chinese tax benefits could hurt our operating results. The Chinese

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government could revoke, terminate or suspend our operating license for reasons related to environmental control over the use of hazardous materials, labor complaints, national security and similar reasons without compensation to us. If the Chinese government were to take any of these actions, we would be prevented from conducting all or part of our business. Any failure on our part to comply with governmental regulations could result in the loss of our ability to manufacture our products.

The Beijing city government has announced that it will expand its offices into the area where our manufacturing facility is located and we believe the Beijing city government intends to relocate thousands of government employees. The Beijing city government desires to upgrade this area and has applied pressure on manufacturing companies that use restricted materials to relocate, including us. It is our understanding that a master development plan of the area where our manufacturing facility is located has not yet been formally approved by the China central government and the timeline for relocating our gallium arsenide wafer production operations at our current site has not yet been determined by the China central government. We are working with the government and are forming a plan to identify a new manufacturing site, acquire land use rights, construct a facility and move our gallium arsenide production line. We intend to complete this relocation by the end of 2018 or the first half of 2019.

The anticipated relocation of all or part of our operations will require us to develop and execute an orderly relocation plan. A failure to properly execute a relocation plan could result in disruption to our production and have a material adverse impact on our revenue and our results of operations and financial condition.

Our international operations are exposed to potential adverse tax consequence in China.

Our international operations create a risk of potential adverse tax consequences. Taxes on income in our China-based companies are dependent upon acceptance of our operational practices and intercompany transfer pricing by local tax authorities as being on an arm's length basis. Due to inconsistencies among taxing authorities in application of the arm's length standard, transfer pricing challenges by tax authorities could, if successful, materially increase our consolidated income tax expense. We are subject to tax audits in China and an audit could result in the assessment of additional income tax against us. This could have a material adverse effect on our operating results or cash flows in the period or periods for which that determination is made and could result in increases to our overall tax expense in subsequent periods. Various taxing agencies in China are increasingly focused on tax reform and other legislative action to increase tax revenue. In addition to risks regarding income tax we have in the past been retroactively assessed value added taxes (“VAT” or sales tax) and such VAT assessments could occur again in the future.

If there are power shortages in China, we may have to temporarily close our China operations, which would adversely impact our ability to manufacture our products and meet customer orders, and would result in reduced revenue.

In the past, China has faced power shortages resulting in power demand outstripping supply in peak periods. Instability in electrical supply has caused sporadic outages among residential and commercial consumers causing the Chinese government to implement tough measures to ease the energy shortage. If further problems with power shortages occur in the future, we may be required to make temporary closures of our operations or of our subsidiary and joint venture operations. We may be unable to manufacture our products and would then be unable to meet customer orders except from inventory on hand. As a result, our revenue could be adversely impacted, and our relationships with our customers could suffer, impacting our ability to generate future revenue. In addition, if power is shut off at any of our facilities at any time, either voluntarily or as a result of unplanned brownouts, during certain phases of our manufacturing process including our crystal growth phase, the work in process may be ruined and rendered unusable, causing us to incur costs that will not be covered by revenue, and negatively impacting our cost of revenue and gross margins.

An outbreak of a contagious disease such as Ebola, Severe Acute Respiratory Syndrome (SARS) or the Avian Flu may adversely impact our manufacturing operations and some of our key suppliers and customers.

Any reoccurrence of SARS or an outbreak of a contagious disease, such as Avian Flu or Ebola, may cause us to temporarily close our manufacturing operations. Similarly, if one or more of our key suppliers is required to close for an

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extended period, we might not have enough raw material inventories to continue manufacturing operations. In addition, while we possess management skills among our China staff that enable us to maintain our manufacturing operations with minimal on-site supervision from our U.S. based staff, our business could also be harmed if travel to or from China and the United States is restricted or inadvisable. If our manufacturing operations were closed for a significant period, we could lose revenue and market share, which would depress our financial performance and could be difficult to recapture. Finally, if one of our key customers is required to close for an extended period, we might not be able to ship product to them, our revenue would decline and our financial performance would suffer.

III. Risks Related to Our Financial Results and Capital Structure

We may utilize our cash balances for relocation, expansion, or to offset a business downturn resulting in the decline of our existing cash, cash equivalents and investment balances, and if we need additional capital, those funds may not be available on acceptable terms, or at all.

Our liquidity is affected by many factors including, among others, our plans to secure land use rights and construct a new facility for the relocation of our gallium arsenide manufacturing operations, the extent to which we pursue on-going capital expenditures, the level of our production, the level of profits or losses, and other factors related to the uncertainties of the industry and global economies. Our relocation expenditures and any negative cash flow effects of these other factors will draw down our cash reserves, which could adversely affect our financial condition, reduce our value and possibly impinge our ability to raise debt and equity funding in the future, at a time when we might need to raise additional cash or elect to raise additional cash. Accordingly, there can be no assurance that events will not require us to seek additional capital or, if required, that such capital would be available on terms acceptable to us, if at all.

Unpredictable fluctuations in our operating results could disappoint analysts or our investors, which could cause our stock price to decline.

We have experienced, and may continue to experience, significant fluctuations in our revenue, gross margins and earnings. Our quarterly and annual revenue and operating results have varied significantly in the past and may vary significantly in the future due to a number of factors, including:

- our ability to develop, manufacture and deliver high quality products in a timely and cost-effective manner;
- disruptions during the relocation of our gallium arsenide product line;
- fluctuation of our manufacturing yields;
- decreases in the prices of our or our competitors' products;
- fluctuations in demand for our products;
- the volume and timing of orders from our customers, and cancellations, push-outs and delays of customer orders once booked;
- decline in general economic conditions or downturns in the industry in which we compete;
- expansion of our manufacturing capacity;
- expansion of our operations in China;
- limited availability and increased cost of raw materials;
- costs incurred in connection with any future acquisitions of businesses or technologies; and

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· increases in our expenses, including expenses for research and development.

Due to these factors, we believe that period-to-period comparisons of our operating results may not be meaningful indicators of our future performance.

A substantial percentage of our operating expenses are fixed, and we may be unable to adjust spending to compensate for an unexpected shortfall in revenue. As a result, any delay in generating revenue could cause our operating results to fall below the expectations of market analysts or investors, which could also cause our stock price to decline.

If our operating results and financial performance do not meet the guidance that we have provided to the public, our stock price may decline.

We provide public guidance on our expected operating and financial results. Although we believe that this guidance provides our stockholders, investors and analysts with a better understanding of our expectations for the future, such guidance is comprised of forward-looking statements subject to the risks and uncertainties described in this report and in our other public filings and public statements. Our actual results may not meet the guidance we have provided. If our operating or financial results do not meet our guidance or the expectations of investment analysts, our stock price may decline.

We have adopted certain anti-takeover measures that may make it more difficult for a third party to acquire us.

Our board of directors has the authority to issue up to 800,000 shares of preferred stock in addition to the outstanding shares of Series A preferred stock and to determine the price, rights, preferences and privileges of those shares without any further vote or action by the stockholders. The rights of the holders of common stock will be subject to, and may be adversely affected by, the rights of the holders of any preferred stock that may be issued in the future. The issuance of shares of preferred stock could have the effect of making it more difficult for a third party to acquire a majority of our outstanding voting stock. We have no present intention to issue additional shares of preferred stock.

Provisions in our restated certificate of incorporation and amended and restated bylaws may have the effect of delaying or preventing a merger, acquisition or change of control, or changes in our management, which could adversely affect the market price of our common stock. The following are some examples of these provisions:

· the division of our board of directors into three separate classes, each with three-year terms;
· the right of our board to elect a director to fill a space created by a board vacancy or the expansion of the board;
· the ability of our board to alter our amended and restated bylaws; and
· the requirement that only our board or the holders of at least 10% of our outstanding shares may call a special meeting of our stockholders.

Furthermore, because we are incorporated in Delaware, we are subject to the provisions of Section 203 of the Delaware General Corporation Law. These provisions prohibit us from engaging in any business combination with any interested stockholder (a stockholder who owns 15% or more of our outstanding voting stock) for a period of three years following the time that such stockholder became an interested stockholder, unless:

· $66^{2}/_{3}$% of the shares of voting stock not owned by the interested stockholder approve the merger or combination, or
· the board of directors approves the merger or combination or the transaction which resulted in the stockholder becoming an interested stockholder.

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Our common stock may be delisted from The Nasdaq Global Select Market, which could negatively impact the price of our common stock and our ability to access the capital markets.

Our common stock is listed on The Nasdaq Global Select Market. The bid price of our common stock has in the past closed below the $1.00 minimum per share bid price required for continued inclusion on The Nasdaq Global Select Market under Marketplace Rule 5450(a). If the bid price of our common stock remains below $1.00 per share for thirty consecutive business days, we could be subject to delisting from the Nasdaq Global Select Market.

Any delisting from The Nasdaq Global Select Market could have an adverse effect on our business and on the trading of our common stock. If a delisting of our common stock were to occur, our common stock would trade in the over-the-counter market and be quoted on a service such as those provided by OTC Markets Group, Inc. Such alternatives are generally considered to be less efficient markets, and our stock price, as well as the liquidity of our common stock, may be adversely impacted as a result. Delisting from The Nasdaq Global Select Market could also have other negative results, including the potential loss of confidence by customers, suppliers and employees, the loss of institutional investor interest and fewer business development opportunities, as well as the loss of liquidity for our stockholders.

Our ability to use our net operating loss carryforwards and certain other tax attributes may be limited.

As of December 31, 2016, we had U.S. federal net operating loss carryforwards of approximately $178.4 million and state net operating loss carryforwards of approximately $1.0 million, which begin expiring in varying amounts from 2022 through 2017 if unused. Under Sections 382 and 383 of the Internal Revenue Code of 1986, as amended, if a corporation undergoes an “ownership change,” the corporation’s ability to use its pre-change net operating loss carryforwards and other pre-change tax attributes, such as research tax credits, to offset its post-change income and taxes may be limited. In general, an “ownership change” occurs if there is a cumulative change in our ownership by “5% shareholders” that exceeds 50 percentage points over a rolling three-year period. Similar rules may apply under state tax laws. We may have undergone prior ownership changes, and we may undergo ownership changes in the future, which may result in limitations on our net operating loss carryforwards and other tax attributes. Any such limitations on our ability to use our net operating loss carryforwards and other tax attributes could adversely impact our business, financial condition and results of operations.

IV. Risks Related to Our Intellectual Property

Intellectual property infringement claims may be costly to resolve and could divert management attention.

Other companies may hold or obtain patents on inventions or may otherwise claim proprietary rights to technology necessary to our business. The markets in which we compete are comprised of competitors that in some cases hold substantial patent portfolios covering aspects of products that could be similar to ours. We could become subject to claims that we are infringing patent, trademark, copyright or other proprietary rights of others. We have in the past been involved in lawsuits alleging patent infringement, and could in the future be involved in similar litigation. For example, we entered into a settlement agreement with Sumitomo in 2011 to settle its claim of patent infringement, which resulted in AXT paying them royalties.

If we are unable to protect our intellectual property, including our non-patented proprietary process technology, we may lose valuable assets or incur costly litigation.

We rely on a combination of patents, copyrights, trademarks, trade secrets and trade secret laws, non-disclosure agreements and other intellectual property protection methods to protect our proprietary technology. We believe that our internal, non-patented proprietary process technology methods, systems and processes are a valuable and critical element of our intellectual property. We must establish and maintain safeguards to avoid the theft of these processes. Our ability to establish and maintain a position of technology leadership also depends on the skills of our development personnel. Despite our efforts to protect our intellectual property, third parties can develop products or processes similar to ours. Our means of protecting our proprietary rights may not be adequate, and our competitors may independently develop similar technology, duplicate our products or design around our patents. We believe that at least two of our competitors

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ship GaAs substrates produced using a process similar to our VGF process. Our competitors may also develop and patent improvements to the VGF technology upon which we rely, and thus may limit any exclusivity we enjoy by virtue of our patents or trade secrets.

It is possible that pending or future United States or foreign patent applications made by us will not be approved, that our issued patents will not protect our intellectual property, or that third parties will challenge our ownership rights or the validity of our patents. In addition, the laws of some foreign countries may not protect our proprietary rights to as great an extent as do the laws of the United States and it may be more difficult to monitor the use of our intellectual property. Our competitors may be able to legitimately ascertain non-patented proprietary technology embedded in our systems. If this occurs, we may not be able to prevent the development of technology substantially similar to ours.

We may have to resort to costly litigation to enforce our intellectual property rights, to protect our trade secrets or know-how or to determine their scope, validity or enforceability. Enforcing or defending our proprietary technology is expensive, could cause us to divert resources and may not prove successful. Our protective measures may prove inadequate to protect our proprietary rights, and if we fail to enforce or protect our rights, we could lose valuable assets.

V. Risks Related to Compliance, Other Legal and Administrative Matters

If we fail to comply with environmental and safety regulations, we may be subject to significant fines or forced to cease our operations; in addition, we could be subject to suits for personal injuries caused by hazardous materials.

We are subject to federal, state and local environmental and safety laws and regulations in all of our operating locations, including laws and regulations of China, such as laws and regulations related to the development, manufacture and use of our products, the use of hazardous materials, the operation of our facilities, and the use of our real property. These laws and regulations govern the use, storage, discharge and disposal of hazardous chemicals during manufacturing, research and development, and sales demonstrations. If we fail to comply with applicable regulations, we could be subject to substantial liability for clean-up efforts, personal injury, fines or suspension or be forced to cease our operations, and/or suspend or terminate the development, manufacture or use of certain of our products, the use of our facilities, or the use of our real property, each of which could have a material adverse effect on our business, financial condition and results of operations.

In addition, from time to time, the Chinese government issues new regulations, which may require additional actions on our part to comply. On February 27, 2015, the China State Administration of Work Safety updated its list of hazardous substances. The previous list, which was published in 2002, did not restrict the materials that we use in our wafers. The new list added gallium arsenide. As a result of the newly published list, we were instructed to obtain a permit to continue to manufacture our gallium arsenide substrate wafers. The Beijing municipal authority accepted our permit application in May 2015, but has not yet issued to us the requisite permit while we continue to make preparations in good faith to eventually relocate our gallium arsenide production. If our application is denied in the future, then our gallium arsenide production could be disrupted, which could materially and adversely impact our results of operations and our financial condition.

For example, in 2005, a complaint was filed against us alleging personal injury, general negligence, intentional tort, wage loss and other damages, including punitive damages, as a result of exposure of plaintiffs to high levels of gallium arsenide in gallium arsenide wafers, and methanol. Other current and/or former employees could bring litigation against us in the future. Although we have put in place engineering, administrative and personnel protective equipment programs to address these issues, our ability to expand or continue to operate our present locations could be restricted or we could be required to acquire costly remediation equipment or incur other significant expenses if we

were found liable for failure to comply with environmental and safety regulations. Existing or future changes in laws or regulations in the United States and China may require us to incur significant expenditures or liabilities, or may restrict our operations. In addition, our employees could be exposed to chemicals or other hazardous materials at our facilities and we may be subject to lawsuits seeking damages for wrongful death or personal injuries allegedly caused by exposure to chemicals or hazardous materials at our facilities.

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Litigation is inherently uncertain and while we would expect to defend ourselves vigorously, it is possible that our business, financial condition, results of operations or cash flows could be affected in any particular period by litigation pending and any additional litigation brought against us. In addition, future litigation could divert management's attention from our business and operations, causing our business and financial results to suffer. We could incur defense or settlement costs in excess of the insurance covering these litigation matters, or that could result in significant judgments against us or cause us to incur costly settlements, in excess of our insurance limits.

We are subject to internal control evaluations and attestation requirements of Section 404 of the Sarbanes Oxley Act.

Pursuant to Section 404 of the Sarbanes Oxley Act of 2002, we must include in our Annual Report on Form 10-K a report of management on the effectiveness of our internal control over financial reporting. Ongoing compliance with this requirement is complex, costly and time-consuming. If: (1) we fail to maintain effective internal control over financial reporting; or (2) our management does not timely assess the adequacy of such internal control, we could be subject to regulatory sanctions and the public's perception of us may be adversely impacted.

We need to continue to improve or implement our systems, procedures and controls.

We rely on certain manual processes for data collection and information processing, as do our joint venture companies. If we fail to manage these procedures properly or fail to effectively manage a transition from manual processes to automated processes, our systems and controls may be disrupted. To manage our business effectively, we may need to implement additional management information systems, further develop our operating, administrative, financial and accounting systems and controls, add experienced senior level managers, and maintain close coordination among our executive, engineering, accounting, marketing, sales and operations organizations.

Item 1B. Unresolved Staff Comments

None.

Item 2. Properties

Our principal properties as of February 27, 2017 are as follows:

Location	Square Feet	Principal Use	Ownership
Fremont, CA	19,467	Administration	Operating lease, expires November 2017
Beijing, China	300,000	Production and Administration	Owned by AXT / Tongmei
Xianxi, China	56,500	Production	Owned by Beijing JiYa Semiconductor Material, Co., Ltd.*
Xianxi, China	7,500	Administration	Owned by Beijing JiYa Semiconductor Material, Co., Ltd.*
Beijing, China	1,500	Administration	Operating lease by Beijing JiYa Semiconductor Material, Co., Ltd., expires March 2017

Nanjing, China	22,000	Production	Owned by Nanjing Jin Mei Gallium Co., Ltd.*
Nanjing, China	5,700	R&D and Administration	Owned by Nanjing Jin Mei Gallium Co., Ltd.*
Nanjing, China	3,900	Production	Owned by Nanjing Jin Mei Gallium Co., Ltd.*
Beijing, China	14,720	Production	Owned by BoYu Semiconductor Vessel Craftwork Technology Co., Ltd.*
Beijing, China	7,600	Production and Administration	Operating leases by BoYu Semiconductor Vessel Craftwork Technology Co., Ltd., expire in various terms until June 2018.*

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*Joint ventures in which we hold an interest and consolidate in our financial statements. We hold a 46% interest in Beijing JiYa Semiconductor Material Co., Ltd., a 83% interest in Nanjing Jin Mei Gallium Co., Ltd., and a 70% interest in Beijing BoYu Semiconductor Vessel Craftwork Technology Co., Ltd.

We consider each facility to be in good operating condition and adequate for its present use, and believe that each facility has sufficient plant capacity to meet its current and anticipated operating requirements.

Item 3. Legal Proceedings

From time to time we may be involved in judicial or administrative proceedings concerning matters arising in the ordinary course of business. We do not expect that any of these matters, individually or in the aggregate, will have a material adverse effect on our business, financial condition, cash flows or results of operation.

Item 4. Mine Safety Disclosures

Not applicable.

PART II

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

Our common stock has been trading publicly on the NASDAQ Global Select Market (NASDAQ) under the symbol “AXTI” since May 20, 1998, the date we consummated our initial public offering, and beginning on January 3, 2011, our common stock began trading on the NASDAQ Global Select Market under the same symbol. The following table sets forth the range of high and low sales prices of the common stock for the periods indicated, as reported by NASDAQ.

	High	Low
2016		
First Quarter	$ 2.97	$ 2.28
Second Quarter	$ 3.92	$ 2.49
Third Quarter	$ 5.21	$ 3.12
Fourth Quarter	$ 5.97	$ 4.35
2015		
First Quarter	$ 3.05	$ 2.36
Second Quarter	$ 2.70	$ 2.22
Third Quarter	$ 2.59	$ 1.91
Fourth Quarter	$ 2.70	$ 1.90

As of February 27, 2017, there were 66 holders of record of our common stock. Because many shares of AXT's common stock are held by brokers and other institutions on behalf of stockholders, we are unable to estimate the total number of beneficial owners of our common stock.

We have never paid or declared any cash dividends on our common stock and do not anticipate paying cash dividends in the foreseeable future. Dividends accrue on our outstanding Series A preferred stock at the rate of $0.20 per annum per share of Series A preferred stock, and must be paid before any dividend is paid on our common stock. The 883,000 shares of Series A preferred stock issued and outstanding as of December 31, 2016 are valued at $3,532,000 and are non-voting and non-convertible preferred stock with a 5.0% cumulative annual dividend rate payable when declared by our board of directors, and a $4.00 per share liquidation preference over common stock that must be paid before any distribution is made to the holders of our common stock. These shares of preferred stock were issued to shareholders of Lyte Optronics, Inc. in connection with the completion of our acquisition of Lyte Optronics, Inc. on May 28, 1999.

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Issuer Purchases of Equity Securities

On February 21, 2013, our Board of Directors approved a stock repurchase program pursuant to which we could repurchase up to $6.0 million of our outstanding common stock through February 27, 2014. The purchases could be made from time to time in the open market and were to be funded from our existing cash balances and cash generated from operations. During 2013, we repurchased approximately 285,000 shares at an average price of $2.52 per share for a total purchase price of $716,000 under the stock repurchase program. As of December 31, 2013, approximately $5.3 million remained available for future repurchases under this program. No shares were repurchased in 2014 under this program and the plan expired on February 27, 2014.

On October 27, 2014, our Board of Directors approved a stock repurchase program pursuant to which we may repurchase up to $5.0 million of our outstanding common stock. These repurchases can be made from time to time in the open market and are funded from our existing cash balances and cash generated from operations. During 2015, we repurchased approximately 908,000 shares at an average price of $2.52 per share for a total purchase price of approximately $2.3 million under the stock repurchase program. No shares were repurchased during 2016 under this program. As of December 31, 2016, approximately $2.7 million remained available for future repurchases under this program.

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Comparison of Stockholder Return

Set forth below is a line graph comparing the annual percentage change in the cumulative total return to the stockholders of the Company on our common stock with the CRSP Total Return Index for the Nasdaq Stock Market (U.S. Companies) and the Nasdaq Electronic Components Index for the period commencing December 31, 2011 and ending December 31, 2016.

	12/11	12/12	12/13	12/14	12/15	12/16
AXT, Inc.	100	67.39	62.59	67.15	59.47	115.11
NASDAQ Composite	100	116.41	165.5	189	200.32	216.54
NASDAQ Electronic Components	100	99.13	142.52	186.42	183.01	236.19

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Item 6. Selected Consolidated Financial Data

The following selected consolidated financial data is derived from and should be read in conjunction with our consolidated financial statements and related notes set forth in Item 8 below, and in our previously filed reports on Form 10 K. See also Item 7. “Management’s Discussion and Analysis of Financial Condition and Results of Operations” for further information relating to items reflecting our results of operations and financial condition.

	Year Ended December 31,				
	2016	2015	2014	2013	2012
	(in thousands, except per share data)				
Statements of Operations Data:					
Revenue	$ 81,349	$ 77,502	$ 83,499	$ 85,335	$ 88,374
Cost of revenue	54,968	60,673	66,332	73,507	63,522
Gross profit	26,381	16,829	17,167	11,828	24,852
Operating expenses:					
Selling, general and administrative	13,880	16,064	14,970	16,066	15,419
Research and development	5,850	5,664	4,144	3,424	3,468
Restructuring charge	226	—	907	—	—
Total operating expenses	19,956	21,728	20,021	19,490	18,887
Income (loss) from operations	6,425	(4,899)	(2,854)	(7,662)	5,965
Interest income, net	409	412	483	408	518
Equity in earnings (loss) of unconsolidated joint ventures	(1,995)	462	1,528	1,377	1,281
Other income (expense), net	860	2,023	361	(748)	(761)
Income (loss) before provision for income taxes	5,699	(2,002)	(482)	(6,625)	7,003
Provision for income taxes	733	531	215	188	853
Net income (loss)	4,966	(2,533)	(697)	(6,813)	6,150
Less: Net (income) loss attributable to noncontrolling interests	670	305	(691)	(1,145)	(3,040)
Net income (loss) attributable to AXT, Inc.	$ 5,636	$ (2,228)	$ (1,388)	$ (7,958)	$ 3,110
Net income (loss) attributable to AXT, Inc. per common share:					
Basic	$ 0.17	$ (0.07)	$ (0.05)	$ (0.25)	$ 0.09
Diluted	$ 0.17	$ (0.07)	$ (0.05)	$ (0.25)	$ 0.09
Shares used in per share calculations:					
Basic	32,139	32,183	32,452	32,700	32,144
Diluted	32,894	32,183	32,452	32,700	32,865

	December 31,				
	2016	2015	2014	2013	2012
	(in thousands)				
Balance Sheet Data:					
Cash and cash equivalents	$ 36,152	$ 24,875	$ 28,814	$ 24,961	$ 30,634
Investments	17,571	19,128	20,123	22,644	19,461

Working capital	94,236	84,047	88,422	84,114	93,376
Total assets	154,246	151,896	161,517	163,822	167,589
Current liabilities	13,050	12,841	14,771	15,426	13,096
Long-term debt, net of current portion	—	—	—	—	—
Stockholders' equity	140,291	137,561	144,688	145,546	150,914

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

In addition to historical information, the following discussion contains forward looking statements that are subject to risks and uncertainties. Actual results may differ substantially from those referred to herein due to a number of factors, including but not limited to risks described in the section entitled Item 1A. "Risk Factors" and elsewhere in this Annual Report. This discussion should be read in conjunction with Item 6. "Selected Consolidated Financial Data" and our consolidated financial statements and related notes included elsewhere in this Form 10-K.

Restructuring Charges

On February 25, 2014, we announced a restructuring plan with respect to our wholly-owned subsidiary, Beijing Tongmei Xtal Technology Co, Ltd., or Tongmei, in order to better align manufacturing capacity with demand. Under the restructuring plan, Tongmei implemented certain workforce reductions with respect to its manufacturing facility in China. We reduced the workforce at Tongmei by approximately 93 positions that were no longer required to support production and operations, or approximately 11 percent of our workforce. We recorded a restructuring charge of approximately $907,000 related to the reduction in force for severance-related expenses.

In the second quarter of 2016, we restructured the operations of Beijing JiYa Semiconductor Material Co., Ltd., one of our partially owned consolidated subsidiaries, which resulted in a reduction in force of 28 positions that were no longer required to support production and operations. Accordingly, we recorded a restructuring charge of approximately $226,000 related to the reduction in force for severance-related expenses. As of June 30, 2016, we had completed this restructuring plan and the reduction in force.

Critical Accounting Policies and Estimates

We prepare our consolidated financial statements in accordance with accounting principles generally accepted in the United States of America. Accordingly, we make estimates, assumptions and judgments that affect the amounts reported on our consolidated financial statements. These estimates, assumptions and judgments about future events and their effects on our results cannot be determined with certainty, and are made based upon our historical experience and on other assumptions that are believed to be reasonable under the circumstances. These estimates may change as new events occur or additional information is obtained, and we may periodically be faced with uncertainties, the outcomes of which are not within our control and may not be known for a prolonged period of time.

We have identified the policies below as critical to our business operations and understanding of our financial condition and results of operations. Critical accounting policies are material to the presentation of our consolidated financial statements and require us to make difficult, subjective or complex judgments that could have a material effect on our financial condition and results of operations. They may require us to make assumptions about matters that are highly uncertain at the time of the estimate. Different estimates that we could have used, or changes in the estimate that are reasonably likely to occur, may have a material impact on our financial condition or results of operations. We also refer you to Note 1 to our consolidated financial statements included elsewhere in this Form 10-K.

Revenue Recognition

We manufacture and sell high-performance compound semiconductor substrates including indium phosphide, semi-conducting and semi-insulating gallium arsenide and germanium wafers, and our three consolidated subsidiaries sell certain raw materials including 99.99% pure gallium (4N Ga), high purity gallium (7N Ga), pyrolytic boron nitride (pBN) crucibles and boron oxide (B2O3). After we ship our products, there are no remaining obligations or customer acceptance requirements that would preclude revenue recognition. Our products are typically sold pursuant

to a purchase order placed by our customers, and our terms and conditions of sale do not require customer acceptance. We recognize revenue upon shipment and transfer of title of products to our customers, which is either upon shipment from our dock, receipt at the customer's dock, or removal from consignment inventory at the customer's location, provided that we have received a valid purchase order, the price is fixed or determinable, title and risk of ownership have transferred, collection of resulting receivables is probable, and product returns are reasonably estimable. We do not provide training, installation or commissioning services.

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We provide for future returns based on historical experience, current economic trends and changes in customer demand at the time revenue is recognized.

Accounts Receivable, Allowance for Doubtful Accounts and Allowance for sales returns

We periodically review the likelihood of collection on our accounts receivable balances and provide an allowance for doubtful accounts receivable primarily based upon the age of these accounts. We evaluate receivables from U.S. customers with an emphasis on balances in excess of 90 days and for receivables from customers located outside the U.S. with an emphasis on balances in excess of 120 days and establish a reserve on the receivable balances if needed. The reason for the difference in the evaluation of receivables between foreign and U.S. customers is that U.S. customers have historically made payments in a shorter period of time than foreign customers. Foreign business practices generally require us to allow customer payment terms that are longer than those accepted in the United States. We assess the probability of collection based on a number of factors, including the length of time a receivable balance has been outstanding, our past history with the customer and their creditworthiness.

As of December 31, 2016 and 2015, our accounts receivable, net balance was $14.5 million and $18.5 million, respectively, which was net of an allowance for doubtful accounts of $653,000 and $561,000, respectively. During 2016, we increased this allowance for doubtful accounts by $92,000 due to the poor financial condition of a few customers. During 2015, we increased this allowance for doubtful accounts by $151,000 primarily because of the poor financial condition of a few customers partially offset by recoveries. No amounts have been written off. If actual uncollectible accounts differ substantially from our estimates, revisions to the estimated allowance for doubtful accounts would be required, which could have a material impact on our financial results for future periods.

The allowance for sales returns is also deducted from gross accounts receivable. During 2016, we utilized $360,000 and charged an additional $296,000 resulting in the ending balance of allowance for sales returns of $360,000 as of December 31, 2016. During 2015, we utilized $423,000 and charged an additional $434,000 resulting in the ending balance of allowance for sales returns of $424,000 as of December 31, 2015.

Warranty Reserve

We maintain a warranty reserve based upon our claims experience during the prior twelve months and any pending claims and returns of which we are aware. Warranty costs are accrued at the time revenue is recognized. As of December 31, 2016 and 2015, accrued product warranties totaled $251,000 and $497,000, respectively. The decrease in accrued product warranties is primarily attributable to decreased claims for quality issues experienced by customers. If actual warranty costs or pending new claims differ substantially from our estimates, revisions to the estimated warranty liability would be required, which could have a material impact on our financial condition and results of operations for future periods.

Inventory Valuation

Inventories are stated at the lower of cost (approximated by standard cost) or market. Cost is determined using the weighted average cost method. Our inventory consists of raw materials as well as finished goods and work-in-process that include material, labor and manufacturing overhead costs. We routinely evaluate the levels of our inventory in light of current market conditions in order to identify excess and obsolete inventory, and we provide a valuation allowance for certain inventories based upon the age and quality of the product and the projections for sale of the completed products. As of December 31, 2016 and 2015, we had an inventory reserve of $12.0 million and $12.0 million, respectively, for excess and obsolete inventory and $254,000 and $625,000, respectively, for lower of cost or market reserves. If actual demand for our products were to be substantially lower than estimated, additional inventory adjustments for excess or obsolete inventory might be required, which could have a material impact on our business,

financial condition and results of operations.

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Impairment of Investments

We classify marketable investments in debt and equity securities as available-for-sale securities in accordance with ASC topic 320, Investments—Debt and Equity Securities ("ASC 320"). All available-for-sale securities with a quoted market value below cost (or adjusted cost) are reviewed in order to determine whether the decline is other-than-temporary. Factors considered in determining whether a loss is temporary include the magnitude of the decline in market value, the length of time the market value has been below cost (or adjusted cost), credit quality, and our ability and intent to hold the securities for a period of time sufficient to allow for any anticipated recovery in market value.

We also invest in equity instruments of privately-held companies in China for business and strategic purposes. Investments in our non-consolidated joint venture companies are classified as other assets and accounted for under either the equity or cost method, depending on whether we have the ability to exercise significant influence over their operations or financial decisions. We monitor our investments for impairment and record reductions in carrying value when events or changes in circumstances indicate that the carrying value may not be recoverable. Determination of impairment is highly subjective and is based on a number of factors, including an assessment of the strength of the subsidiary's management, the length of time and extent to which the fair value has been less than our cost basis, the financial condition and near-term prospects of the subsidiary, fundamental changes to the business prospects of the subsidiary, share prices of subsequent offerings, and our intent and ability to hold the investment for a period of time sufficient to allow for any anticipated recovery in our carrying value. We had no write downs in 2016, 2015 and 2014.

Fair Value of Investments

ASC topic 820, Fair Value Measurement ("ASC 820") establishes three levels of inputs that may be used to measure fair value.

Level 1 instruments represent quoted prices in active markets. Therefore, determining fair value for Level 1 instruments does not require significant management judgment, and the estimation is not difficult.

Level 2 instruments include observable inputs other than Level 1 prices, such as quoted prices for similar instruments in markets with insufficient volume or infrequent transactions (less active markets), issuer bank statements, credit ratings, non-binding market consensus prices that can be corroborated with observable market data, model-derived valuations in which all significant inputs are observable or can be derived principally from or corroborated with observable market data for substantially the full term of the assets or liabilities, or quoted prices for similar assets or liabilities. These Level 2 instruments require more management judgment and subjectivity compared to Level 1 instruments, including:

- Determining which instruments are most comparable to the instrument being priced requires management to identify a sample of similar securities based on the coupon rates, maturity, issuer, credit rating, and instrument type, and subjectively select an individual security or multiple securities that are deemed most similar to the security being priced.
- Determining which model-derived valuations to use in determining fair value requires management judgment. When observable market prices for similar securities or similar securities are not available, we price our marketable debt instruments using non-binding market consensus prices that are corroborated with observable market data or pricing models, such as discounted cash flow models, with all significant inputs derived from or corroborated with observable market data.

Level 3 instruments include unobservable inputs to the valuation methodology that are significant to the measurement of fair value of assets or liabilities. The determination of fair value for Level 3 instruments requires the most management judgment and subjectivity.

We place short-term foreign currency hedges that are intended to offset the potential cash exposure related to fluctuations in the exchange rate between the United States dollar and Japanese yen. We measure the fair value of these foreign currency hedges at each month end and quarter end using current exchange rates and in accordance with

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generally accepted accounting principles. At quarter end any foreign currency hedges not settled are netted in "accrued liabilities" on the consolidated balance sheet and classified as Level 3 assets and liabilities. As of December 31, 2016 and 2015, the net change in fair value from the placement of the hedge to settlement at each month end during the quarter had a de minimis impact to the consolidated results.

Impairment of Long-Lived Assets

We evaluate the recoverability of property, equipment and intangible assets in accordance with ASC topic 360, Property, Plant and Equipment ("ASC 360"). When events and circumstances indicate that long-lived assets may be impaired, we compare the carrying value of the long-lived assets to the projection of future undiscounted cash flows attributable to such assets. In the event that the carrying value exceeds the future undiscounted cash flows, we record an impairment charge against income equal to the excess of the carrying value over the asset's fair value. Fair values are determined based on quoted market values, discounted cash flows or internal and external appraisals, as applicable. Assets held for sale are carried at the lower of carrying value or estimated net realizable value. We had no "Assets held for sale" on the consolidated balance sheet as of December 31, 2016 and 2015.

Stock-Based Compensation

We account for stock-based compensation in accordance with ASC topic 718, Stock-based Compensation ("ASC 718"). Share-based awards granted include stock options and restricted stock awards. We utilize the Black Scholes option pricing model to estimate the grant date fair value of stock options, which requires the input of highly subjective assumptions, including estimating stock price volatility and expected term. Historical volatility of our stock price was used while the expected term for our options was estimated based on historical option exercise behavior and post-vesting forfeitures of options, and the contractual term, the vesting period and the expected term of the outstanding options. Further, we apply an expected forfeiture rate in determining the amount of share-based compensation. We use historical forfeitures to estimate the rate of future forfeitures. Changes in these inputs and assumptions can materially affect the measure of estimated fair value of our stock compensation. The cost of restricted stock awards is determined using the fair value of our common stock on the date of grant.

We recognize the compensation costs net of an estimated forfeiture rate over the requisite service period of the options award, which is generally the vesting term of four years. Compensation expense for restricted stock awards is recognized over the vesting period, which is generally one, three or four years. Stock-based compensation expense is recorded in cost of revenue, research and development, and selling, general and administrative expenses. (see Note 1—Summary of Significant Accounting Policies—Stock Based Compensation).

Income Taxes

We account for income taxes in accordance with ASC topic 740, Income Taxes ("ASC 740"), which requires that deferred tax assets and liabilities be recognized using enacted tax rates for the effect of temporary differences between the book and tax bases of recorded assets and liabilities. ASC 740 also requires that deferred tax assets be reduced by a valuation allowance if it is more likely than not that a portion of the deferred tax asset will not be realized.

We provide for income taxes based upon the geographic composition of worldwide earnings and tax regulations governing each region, particularly China. The calculation of tax liabilities involves significant judgment in estimating the impact of uncertainties in the application of complex tax laws, particularly in foreign countries such as China.

See Note 13—"Income Taxes" in the consolidated financial statements for additional information.

Results of Operations

Overview

We were founded in 1986 to commercialize and enhance our proprietary vertical gradient freeze (VGF) technology for producing high-performance compound semiconductor substrates or wafers. We have one operating

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segment and two product lines: specialty material substrates and raw materials used to make such substrates or other related products. We recorded our first substrate sales in 1990 and our substrate products currently include indium phosphide (InP), gallium arsenide (GaAs) and germanium (Ge) substrates used to produce semiconductor devices for use in applications such as fiber optic and wireless telecommunications, light emitting diodes (LEDs), lasers and for solar cells for space and terrestrial photovoltaic applications. We also sell raw materials, including gallium and germanium, through our participation in majority and minority owned subsidiaries and joint ventures.

Operating Results

We manufacture all of our products in the People's Republic of China (PRC or China), which generally has favorable costs for facilities and labor compared with comparable facilities in the United States, Europe or Japan. Our supply chain includes partial ownership of 10 companies in China (joint ventures). We believe this supply chain arrangement provides us with pricing advantages, reliable supply and enhanced sourcing lead-times for key raw materials which are central to our final manufactured products.

Our annual revenue declined for four consecutive years during the period from 2012 to 2015. Our annual revenue increased in 2016 by 5 percent. The period of decline was primarily a result of silicon chips replacing GaAs chips in the mobile phone switching function. Before 2012, silicon chips did not perform adequately in this function due to power consumption, heat and speed issues. The development of the silicon-on-insulator technique overcame these deficiencies and provided a lower cost solution for mobile phone switches and our annual revenue declined from $104 million in 2011 to $88 million in 2012. The decline in GaAs revenue was partially mitigated by revenue growth in our InP wafers. We believe our product and customer diversity also mitigated the decline in revenue. In 2016 GaAs revenue increased, as did revenue of all of our substrate material revenue. However, this increase was partially offset by a decrease in revenue from our raw materials product line.

In the first quarter of 2014, we reduced our work force by approximately 11% and embarked on a number of additional cost reduction programs, primarily in our substrate manufacturing, which has the highest costs as compared to research and development or selling and administrative expenses. In 2015, we invested in wafer manufacturing equipment to increase automation and decrease the number of manually operated processing steps in our production flow. We believe this can improve our manufacturing yields, product quality and product consistency. In addition to revenue growth in 2016, we also increased our gross margins as a result of increased yields and manufacturing efficiencies. We intend to continue to focus on InP substrates as we believe InP can continue to be an engine for growth if, for example, the data center expansion and upgrade cycle begins. We are also investing in six-inch low defect density ("low EPD") GaAs substrates that are required for 3D-Sensing using vertical cavity surface emitting lasers ("VCSELs"). In the second quarter of 2016, we implemented a cost reduction program and reduced our workforce by 28 positions.

Revenue

	Years Ended Dec. 31			2015 to 2016 Increase		2014 to 2015 Increase	
	2016	2015	2014	(Decrease)	% Change	(Decrease)	% Change
Product Type:							
Substrates	$ 65,633	$ 58,220	$ 60,178	$ 7,413	12.7 %	$ (1,958)	(3.3) %
Raw Materials and Others	15,716	19,282	23,321	(3,566)	(18.5) %	(4,039)	(17.3) %
Total revenue	$ 81,349	$ 77,502	$ 83,499	$ 3,847	5.0 %	$ (5,997)	(7.2) %

Revenue increased $3.8 million, or 5.0% in 2016 from $77.5 million in 2015. The $7.4 million increase in substrate sales was partially offset by the decrease of our raw material sales from our consolidated subsidiaries. The average selling price of each type of wafer was unchanged or it declined. The revenue increase is the result of higher unit volume and a shift towards wafers with higher selling prices. Raw material sales decreased by $3.6 million or 18.5%, partially offsetting the increase in our substrate product line. The decline of raw material sales is the result of decreasing average selling prices of both raw gallium and purified gallium by 29% while quantity sold remains consistence, which were partially offset by the increase of average selling price of pBN.

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Revenue decreased $6.0 million, or 7.2%, to $77.5 million in 2015 from $83.5 million in 2014. In particular, our sales of GaAs substrate materials that are used to produce LEDs declined by $6.3 million. The LED market encountered severe pricing pressure and we withdrew from the lower performance segment of the LED market. We also experienced a slowdown in the satellite solar cell market, which resulted in an additional decline in the sale of Ge substrate materials of $2.5 million. In addition, in 2015 raw material sales decreased approximately $4.0 million due to a reduction of the average selling price of gallium. These declines were partially offset by our sales of InP substrate materials used in the production of passive optical networks (PONs) for fiber-to-the-home and office networks in the amount of $7.3 million.

Revenue by Geographic Region