

ENTEGRIS REVEALS LESSONS FROM THE SEMICONDUCTOR INDUSTRY THAT WILL SHAPE THE FUTURE OF LIFE SCIENCES MANUFACTURING

Transferrable technology, specialty materials and supply chain management strategies present new opportunities to innovate.

Billerica, MA, October 19, 2021 – [Entegris, Inc.](#) (NASDAQ: ENTG), a world-class supplier of advanced materials and process solutions for the semiconductor and other high-technology industries, today revealed lessons learned from its semiconductor business that have the potential to transform production and storage in the life sciences industry. These cross-industry applications may enable safer, more efficient production of biologics, and cell and gene therapies of the future.

John Lynch, vice president of Life Sciences at Entegris, has more than 30 years of scientific, technical, and business leadership experience focused on innovation and growth in the life sciences and other markets. He joined Entegris in 2017 and has been integral to developing the company's life sciences capabilities.

Lynch says, "Manufacturing of emerging new therapies, such as mRNA vaccines and cell and gene therapies are ripe for transformation. There is a strong need for new tools and ways of working to help life sciences companies improve purity and yield while solving critical public health issues. In any industry, sometimes looking outside of your own market for answers is the fastest way to drive innovation.

"Although they produce very different products, the semiconductor and life sciences industries have a lot in common. Both have some of the most complex manufacturing processes and both must eliminate process variation. Rapid innovation, advanced materials, and effective supply chain management are all key to success in both industries," Lynch said.

Three of the top lessons from the semiconductor industry currently being implemented into biopharma manufacturing include:

1. Processes developed by the semiconductor industry that identify and reduce contaminants are being deployed to improve the purity and yield of drug substances.

By its nature, the semiconductor industry must have strong expertise in the characterization and control of nanoparticles. For example, semiconductor companies build devices characterized by sizes or nodes in the single nanometer dimensions, and then engineer materials on those devices that have a cross section of about five nanometers. In comparison, a strand of DNA is only two nanometers across. Therefore, the semiconductor industry routinely engineers materials at atomic scale dimensions where controlling impurities and defects is imperative to achieving acceptable yield. Particles are typically controlled at single nanometer dimensions and metal contamination at the parts per quadrillion (PPQ) level.

In life sciences, particles are also increasingly a concern. Unidentified particles in the final drug product may prevent the full lot from being released, which could lead to wasted resources and significant financial losses. Many cell therapies are unable to use filtration to reduce particle burden, since filtration removes the cells which are the final product. For this reason, other solutions need to be identified. Existing technologies from the semiconductor industry – from monitoring techniques to measurement tools – can be instrumental in identifying and minimizing particle burden in life sciences processes.

According to Lynch, “Unidentified particles in both the semiconductor and biologics manufacturing processes can lead to defects and contamination that can negatively impact yield. Due to the much smaller particle sizes in the semiconductor industry, particle identification is highly precise. The processes used in semiconductor manufacturing can offer significant improvements in purity and yield for the life sciences industry by reducing particle burden at the end of manufacturing and reducing contaminants in the final drug formulations.”

2. Materials used in semiconductor manufacturing are supporting extreme temperature demands required by new drug substances.

High performance polymers, which are well-established in the semiconductor industry, offer substantial material advantages. They are chemically resistant to aggressive chemicals used in semiconductor manufacturing processes. In addition, they can be used effectively in complex manufacturing environments characterized by extreme temperature requirements – either cryogenic or elevated temperatures. For example, they can tolerate the extreme temperature requirements in semiconductor processes such as a wet chemical bath that can reach 180°C.

As freeze storage becomes increasingly important in the life sciences industry with more drugs, therapies, and vaccines – including the COVID-19 vaccine – requiring precise cryogenic temperatures, this expertise can be applied to the life sciences industry. High performance polymers not only offer distinctive features for handling frozen bulk drug substances, they are also one of the cleanest and most robust solutions on the market right now. Such high performance materials are a preferred solution for freezing, transporting, storing, and thawing drug substances, since they result in less contamination and breakage.

Lynch says, “High performance polymers are incredibly robust. They can handle cryogenic temperatures and can withstand gamma sterilization, which makes them useful for AAV, mRNA vaccines and protein applications in cell and gene therapy production. Our Aramus™ single-use assemblies are made of single-layer high performance polymers, and many leading biopharma companies have expressed strong interest in using this innovation, and several customers are currently incorporating it into their production.”

3. Semiconductor supply chain strength and resilience is being leveraged to scale up production of biologic therapies like COVID-19 vaccines.

The semiconductor industry has historically been well-positioned to respond to periods of high demand without disruption in large part due to its supply chain management systems. Reporting tools with

statistical modeling capabilities deliver production teams timely and accurate information and critical metrics, such as safety stocks and logistic lead times. Supply chain digitization provides the ability to respond rapidly to demands and communicate with suppliers quickly.

The real-time data is underpinned by a strong, dynamic network of suppliers, which ensure semiconductor companies – and their partners – are prepared with back-up plans in the event one supplier is unable to meet the current demand.

Lynch explains, “Resiliency is key to both the semiconductor and life sciences industries. Biopharma has always depended on rapid innovation, high-quality and reliable supply to provide life-sustaining innovations worldwide, and this dependence has escalated significantly due to the COVID-19 pandemic. New supply chain management tools, like those used by the semiconductor industry, can help biopharma companies forge strong relationships with suppliers and leverage technology to provide real-time end-to-end updates to predict and solve potential issues before they occur.”

Lynch concludes, “The semiconductor industry offers highly controlled processes, advanced specialty materials and leading-edge technology that can deliver valuable benefits for life sciences manufacturing. What’s more, we should also embrace the semiconductor industry’s ‘spirit of collaboration’ in which producers partner with their peers on R&D initiatives to lift the industry as a whole. These lessons from our vast experience serving the semiconductor industry can be leveraged by life sciences companies to pave the way to better support novel biologic therapies of the future, including the successful delivery of COVID-19 vaccines worldwide.”

To learn about how Entegris is supporting the life sciences sector, visit <https://lifesciences.entegris.com>.

About Entegris

Entegris is a world-class supplier of advanced materials and process solutions for the semiconductor and other high-technology industries. Entegris has approximately 6,600 employees throughout its global operations and is ISO 9001 certified. It has manufacturing, customer service, and/or research facilities in the United States, Canada, China, France, Germany, Israel, Japan, Malaysia, Singapore, South Korea, and Taiwan. Additional information may be found at www.entegris.com.

Forward-Looking Statements

This news release contains forward-looking statements. The words “believe,” “expect,” “anticipate,” “intend,” “estimate,” “forecast,” “project,” “should,” “may,” “will,” “would” or the negative thereof and similar expressions are intended to identify such forward-looking statements. These forward-looking statements include statements related to applications of Entegris’ products, services, and technology; trends in the semiconductor and life sciences industries; and other matters. These statements involve risks and uncertainties, and actual results may differ materially from those projected in the forward-looking statements. These risks and uncertainties include, but are not limited to, those risk factors and additional information described in Entegris’ filings with the Securities and Exchange Commission, including under the heading “Risk Factors” in Item 1A of Entegris’ Annual Report on Form 10-K for the fiscal year ended December 31, 2020, filed with the Securities and Exchange Commission on February 5, 2021, and in Entegris’ other periodic filings.

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