Zero Defects

Entegris Newsletter

April 2019

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Taiwan Intellectual Property Court Finds Gudeng Precision Industrial Co., Ltd. Infringed Entegris' Reticle Pod Patent

Entegris received an oral judgment on March 22, from the Taiwan Intellectual Property Court finding that Gudeng Precision Industrial Co., Ltd. infringes Entegris' Taiwan Patent No. I-317967. The judgment against Gudeng awarded Entegris NT$978,869,835 (US $32.6M) in damages and includes an order that Gudeng recall and destroy its infringing products.

Importantly, the presiding judge stated that Gudeng shall not directly or indirectly manufacture, offer for sale, sell, use, or import the infringing Reticle SMIF Pod and other products that will infringe Entegris' rights of R.O.C. Invention Patent No. I 317967 entitled "Reticle Carrier Including Reticle, Positioning and Location Means." Additionally, the judge instructed that Gudeng may recall and destroy infringing reticle pods.

The Entegris EUV 1010 reticle pod repre-sents a significant breakthrough in improving mask defectivity so customers implementing HVM for advance technology nodes can focus on increasing efficiency and throughput. The EUV 1010 was the first to be qualified by ASML for use in the NXE:3400B and beyond.

Entegris Breaks Ground on New High-Purity Drum Manufacturing Facility

50% increase in HDPE drum capacity with addition of two new blowmolders

On May 8th, 2019, we celebrated the $20M USD expansion of the new HDPE drum production facility. It is one of our state-of-the-art clean facilities in JangAn, Korea. We have hosted several Government Officials, Samsung, SK Hynix, and Chemical company customers.

With the expansion of the drum facility, we are ready to meet the high-purity chemical delivery requirements in Asia, including Korea. Entegris will increase its "highly pure" HDPE drum manufacturing capacity by 50% once the facility opens in the second half of 2020.

The JangAn facility, and its planned HDPE drum capacity increase, will provide chemical manufacturers with greater supply security, and shorter lead times. This will provide the speed and reliability that manufacturers need to capitalize on the opportunities of the Fourth Industrial Revolution.

ENTEGRIS ASIA

A question about Entegris products?
Call your customer service center

China
Shanghai
T +86 21 8023 6500
F +86 21 5080 5598

Beijing
T +86 10 6552 8840
F +86 10 6552 8840 - 8002

Xi'an
T +86 29 8860 0785
F +86 29 8860 0785

South East Asia
Malaysia
T +60 4 427 4200
F +60 4 641 3294

Singapore
T +65 6745 2422
F +65 6745 4477

Taiwan
Hsinchu
T +886 3 571 0178
F +886 3 572 9520

Tainan
T +886 6 589 6008
F +886 6 501 3799

Korea
T +81 31 8065 8300
F +81 31 8065 8301

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Examining the Role of Contamination in Automotive Reliability Failures

By Entegris Inc.

CHALLENGES AND OPPORTUNITIES

The evolution of transportation continues to drive challenges and opportunities for semiconductor fabs. The "leading-edge" and "mainstream" IC fabricators are required to ensure longer lifetimes (15+ years) while maintaining yield and parametric performance levels. Materials contamination, recognized as a barrier to efficient yield and parametric performance, is now being evaluated as a potential source of reliability failures discovered in the early, mid, and later years of the vehicle. As vehicle components shift more toward digital systems, the reliability challenge is compounded with increased volume and device variety found in these new devices.

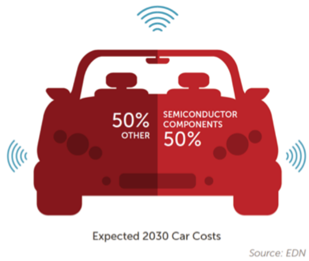


Figure 1. Projected semiconductor component costs of cars in 2030

THE CHALLENGE OF MANUFACTURING NEW DIGITAL SYSTEMS

Entegris' Wenge Yang, VP Market Development, was recently featured in [Solid State Technology](#) to share his perspective on the challenge this scenario presents and the solutions available. "*Many existing and mainstream fabs are yielding high 90 percent range. However, we recently found that particles that are small enough to not cause a reduction in chip yield an still cause reliability issues down the road. This has triggered Entegris to become an industry advocate on a new effort to reduce contaminants even further than has been practiced up to now.*" — Yang.

Examining the Small, Medium, and Large of Increasing Automotive Device Reliability

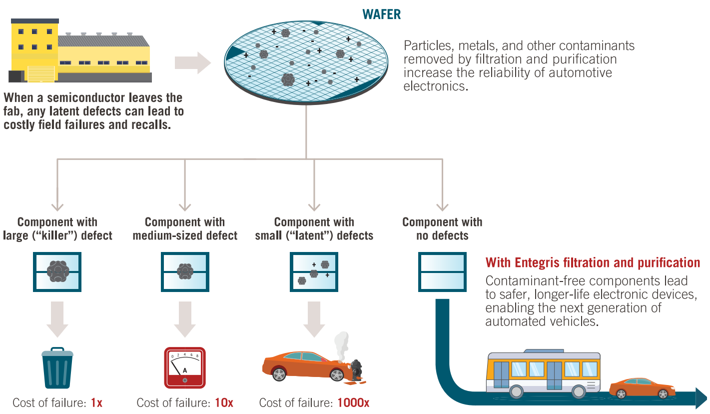


Figure 2. The cost of failure in automotive electronics.

As the semiconductor industry is now enabling driver-assist and fully automated vehicle technologies, the supply chain is in need of solutions to design and manufacturer vehicles that can meet the standards set for safety, performance, cost, and reliability.

THE SOLUTION IS IN COLLABORATION

Figure 3. Various-sized particles captured in a chemical filter.

A New Collaborative Approach (NCA) brings the automaker, fabs, suppliers, and academia together to examine the role of contamination and process variations in the formation of defects that may cause reliability failures. Entegris' Antoine Amade, Senior Regional Director, recently presented at the Strategic Materials Conference in Dresden, Germany to introduce the NCA model. [SEMI](#) recently shared an interview from the event. "*The new collaborative approach is a journey. It is a consultative process to provide a fresh set of eyes and expertise on the key areas of concerns in the fabs. It is a multidisciplinary approach with zero defectivity as the main goal. It is focused on baseline improvement, better process control, more uniformity and prevention of excursions.*" — Amade.

The Entegris team is eager to collaborate to develop the solutions among automakers, semiconductor fabs and their suppliers of process tools, materials, and services. Take a look at the details of the examination project underway and consider participating in our survey to understand the reliability sentiments and concerns of the automotive and semiconductor markets.

Read the paper and watch the video to learn more
www.entegris.com/automotive

Join the conversation
survey automotive

Enabling Advanced Lithography: The Challenges of Storing and Transporting EUV Reticles

By Entegris Inc.

Extreme ultraviolet (EUV) lithography is expanding into high-volume production as the semiconductor industry continues to push the envelope of ever-shrinking design dimensions. For advanced nodes at and below 7 nm, EUV lithography is an enabling technology for streamlining the patterning process. Reliable patternmaking at such a fine scale requires ultraclean reticles.

Like all reticles, those used for EUV lithography rely on reticle pods for safe storage and to protect them during lithographic patterning, inspection, cleaning, and repair. The protective pod must last for many years without introducing unwanted contamination or physical damage.

Pods designed for 193 nm immersion lithography are not sufficient to protect EUV reticles. The unique requirements of EUV lithography pose additional constraints and demands on pods, making the EUV reticle pod a highly specialized piece of equipment with multiple critical components.

This paper explains **the challenges inherent in designing pods for EUV lithography** and **proposes solutions that will allow more fabs to implement advanced lithography nodes** at their facilities.

PROTECTING EUV RETICLES

The finer the lithographic patterns, the greater the risk reticle contamination poses. Potential contamination sources include both foreign particles and chemical residues. Reticle coatings are delicate and easily damaged. Anything that touches a reticle, whether it is an expected part of the process such as a robot arm in the fab or an unexpected contaminant such as a human hair, has the potential to cause damage.

Immersion lithography relies on pellicles to act as "dustcovers" that protect reticles from particle contamination during pattern exposure. Pellicles need to be optically transparent, which in the case of EUV lithography means that they must be transparent to light in the EUV spectrum with wavelengths around 13.5 nm. Most existing pellicle film materials absorb EUV light, but the semiconductor industry is starting to implement EUV-specific pellicles (see Figure 1).

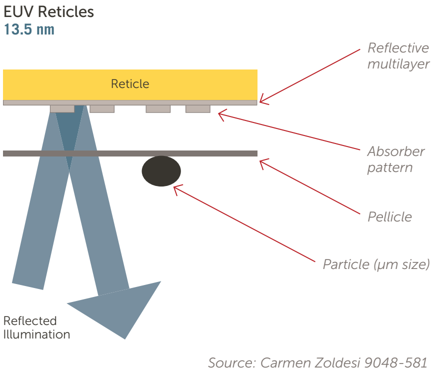


Figure 1. Incorporating a pellicle into an EUV reticle

Until pellicles become standard for EUV lithography, EUV pods need to protect reticles that do not include a pellicle. The NXE tools for EUV lithography require a dual-pod configuration consisting of an inner metal pod under vacuum and an outer pod with access to the ambient environment. The inner pod is only opened when the pod is inside the tool.

The dual-pod configuration is standard practice for EUV lithography, and such pods are commercially available. Just because they are readily available, however, does not mean that they are a commodity product. EUV pod designs (see Figure 2) continue to evolve to meet demands for performance and lithography throughput.

Figure 2. Dual-pod configuration for EUV lithography showing outer pod (left) and inner pod (right).

Despite the protection that the dual-pod configuration conveys, the potential for contamination is significant. For this reason, EUV pods must be developed with contamination risk mitigation in mind. Especially for reticles that do not include a pellicle, the inner pod is the primary source of both protection and potential contamination.

Pod design considerations cover both the geometry of the inner and outer pods and the materials from which they are made.

ACCOMMODATING PELLICLES

Because reticle pods are intended to last many years, they must meet the needs of current and future EUV lithography. Today's pod designers, therefore, should consider a version that includes space to accommodate a pellicle as well as a version for use without a pellicle. It is possible to modify the inner pod by adding a pellicle pocket in a way that still meets the overall size and weight requirements of the pod.

Designing a pellicle-compatible pod requires close collaboration between the pod manufacturer, pellicle supplier, and lithography tool manufacturer. Automated equipment assumes a tight range of weight for the inner pod, which means that the similar weight of material removed to create the pellicle pocket must be added elsewhere in the pod. The pellicle geometry must be considered when locating contact points and windows in the inner pod.

For more details, download the full version Link

Novel Safe Approach to Process Gas Delivery

By Entegris Inc.

Gases are typically available in a compressed (high pressure) format, or in some cases, set to deliver at lower pressures — typically subatmospherically. The adoption of Subatmospheric pressure Gas Systems (SAGS) gas storage and delivery technologies has occurred steadily over the last 25 years, mainly in the semiconductor industry. Used initially to supply highly toxic dopants for ion implantation, the number of tool types and applications employing SAGS continues to increase every year. In fact, offerings based on SAGS technology have now expanded to 50-liter and larger cylinders, support a wide variety of gases and gas mixtures, and can even be calibrated to deliver at low positive pressures for processes that require positive pressure.

Prior to the introduction of SAGS technology gas, process gases were delivered as a very dilute mixture. Phosphine and arsine, for example, were typically limited to very small cylinders of 15% gas in balance hydrogen. This was due to the risk of releasing these highly toxic gases from the high-pressure cylinders. With the introduction of SAGS, suddenly users were able to use 100% phosphine, arsine, and other toxic gases in an inherently safe package/gas cylinder. This provided huge benefits to users. **Ion implanter throughput, tool performance, and time between maintenance events were all drastically improved**. **The impact of SAGS technology to the worldwide ion implanter base allowed improved fab design and reduced the number of implanters required due to significantly higher tool availability and higher tool throughput.**

SAFETY IMPLICATIONS AND LOW-PRESSURE GAS DELIVERY

All gas cylinders, high pressure or SAGS, can have connection problems if proper procedures are not followed or other failures occur. The difference will be in the impact to the operators, equipment, and environment.

Worst case release rates for gases are predicated on gas pressure and flow through an orifice. In the 1980's, the use of restrictive flow orifices (RFO) became commonplace and allowed users to develop more comprehensive safety practices, e.g., setting minimum ventilation rates for gas enclosures as well as sizing scrubbers to abate releases. The RFO effectively limited gas releases to more manageable levels but didn't eliminate them.

Today users have options. In contrast to high-pressure gas sources, Type 1 SAGS, Vacuum Actuated Cylinder (VAC®), which is a Type 2 SAGS, and low-pressure delivery systems such as **Entegris' PDS®+100 gas cylinder, effectively eliminate gas releases as a concern.** Users and gas component suppliers recognize the benefit of a low positive pressure for safety as well as equipment reliability purposes. Higher pressure within the gas delivery system typically reduces component lifetimes.

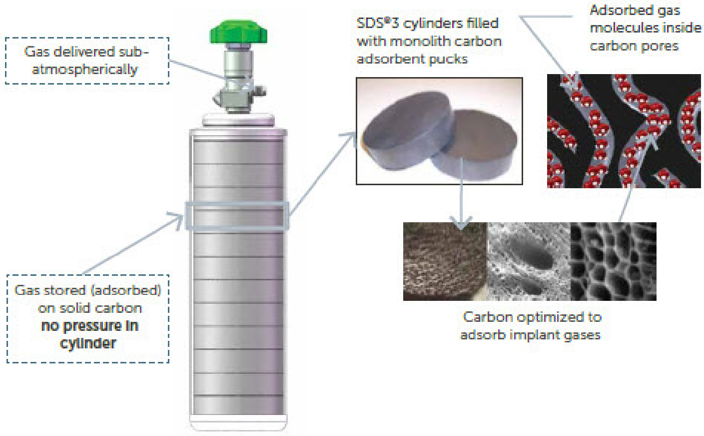
Entegris BF_3 VAC® and PDS® + 100 cylinders.

GAS MIXTURES ENHANCING PRODUCT RESULTS AND ENABLING NEW PROCESS

Unlike the very dilute inefficient gas mixtures that had been used in ion implant prior to the introduction of SAGS, a new class of highly specialized gas mixtures are being widely adopted. **VAC-based SAGS cylinders have been adopted to supply specialized gas mixtures that can enhance process performance, improve product results, and even enable new processes.** There is a trend of users adopting gas mixtures from VAC-based SAGS cylinders to limit risk while achieving the benefits of the precision mixture.

ENTEGRIS SOLUTIONS FOR ACCIDENT-FREE GAS DELIVERY

By storing and delivering toxic or pyrophoric gases at subatmospheric pressures, **SDS cylinders improve operation efficiency and are the safest option available**. Entegris offers a complete range of process gas delivery solutions to realize operational, process, and product benefits, and continues to set the industry standard for safety, quality, expertise, and innovation in gas delivery.



SDS is the safest gas package available in the industry for highly toxic, pyrophoric, or corrosive gases

For more details, download the white paper Link

Handling Wafers with Entegris Electrostatic Chucks

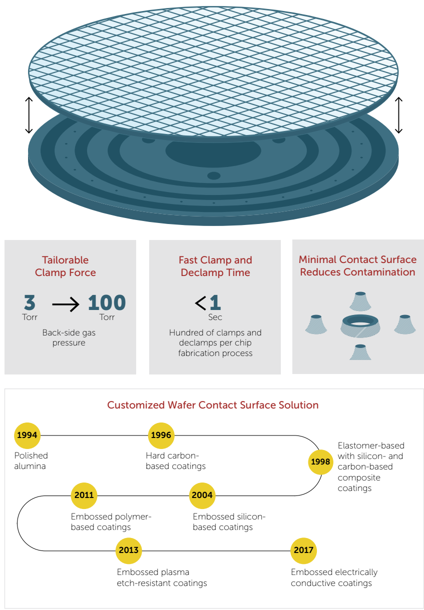
Leveraging proprietary coating technologies and innovative manufacturing capabilities, Entegris electrostatic chucks offer a very flat clamped wafer surface, uniform thermal properties, improved gas-cooling, superior plasma erosion resistance, and ultra-low particle and metal generation. These advanced wafer contact surfaces are made of materials with tailorable electrical properties, have an **optimal wafer contact area that improves overall performance and lifetime while minimizing contamination**.

BENEFITS

- Low particle and metal generation
- Fast clamping and de-clamping
- Reliable wafer clamping consistency

Handling wafers with E-Chucks

Advanced and smart solution through continuous technical innovation and collaboration for 20 years



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