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Entegris opens new coatings facility in France

The new European coatings facility, Entegris Specialty Coatings (ESC), is up and running. Located in the Techlid activity park in Lyon, France, the facility is strategically located close to the Grenoble area, which is a hub for nanotechnology activity in Europe, and is near the "Plastics Valley" in France. The new ESC facility, which is located in the same building as Entegris' Poco Graphite European office, brings coatings capabilities closer to our existing customers in Europe and will allow for faster response and service.

ESC Europe has 400 m² dedicated to coatings activities featuring **Ultra High Purity Silicon (UHP Silicon)** and **Diamond Like Carbon (UltraC™) families of coatings**. The facility is equipped with a clean room, state-of-the-art coating equipment and characterization capabilities.

Entegris will now have the opportunity to apply locally UHP Silicon and UltraC based coatings, which are dense, micro-conformal, highly adherent and extremely smooth for a variety of applications. The coatings are deposited by a proprietary Plasma Enhanced Chemical Vapor



Deposition (PECVD) process which is versatile and allows for a high degree of flexibility in coating a variety of substrate materials. The Silicon coatings have low internal stress, therefore can be deposited in thicknesses ranging from <1 µm to 100+ µm depending on substrate material and finish.

▶ UHP Silicon based coatings are ideal in Semiconductor wafer processing, **where the reduction of particle and metal contamination is vital**. The UltraC coatings can be deposited in thicknesses ranging from <1 µm to 10 µm based on substrate material, geometry and finish.

▶ The UltraC coatings are useful in semiconductor applications **where friction and particle reduction may be an issue**. UltraC Diamond Like Carbon (DLC) coatings for plastic injection mold components have generated extraordinary interest in the United States and expected to do the same in Europe.

Entegris to present on a new retention method for sub-10 nm liquid filtration

It is the purpose of the **UCPSS-symposium** to increase the level of understanding on ultra-clean processing technology and contamination control in all steps of the IC-production and PV manufacturing.

As a major sponsor of this event, Entegris will exhibit and present on a **new retention method for sub-10 nm liquid filtration**. For such tight membranes, the pore-size ratings can only be estimated by bubble-point extrapolation techniques, instead of a particle challenge tests. Therefore, it is essential to develop a new rating method that can measure sub-10

nm particle retention directly. In this report, fluorescent CdSe quantum dots (QDs)²⁻⁴ were used to rate the retention efficiency of nanofiltration membranes.

Scientific program: [link](#)

Take the opportunity to meet us during this symposium, Belgium September 16-19th 2012. We will be pleased to discuss with you on the advances in ultra-cleaning.


creating a material advantage

Process Stability

Applications of ozonated water for improved cleaning performance

By Fariba Rahman, Membrane Contacting Applications Engineer - Entegris, Inc.

Interest in ozonated water is growing in semiconductor wafer and photovoltaic substrate cleaning applications due to its strong oxidizing potential coupled with low environmental impact.

Applications of ozone in water in the semiconductor industry

Research has shown ozonated de-ionized (DI) water to be a cheaper and more environmentally friendly agent in wafer processing and cleaning when compared to many of the aggressive chemistries currently used as reagents in wafer processing technologies. Some of the main areas of interest for ozone/DI water application in wafer processing are explained hereinafter:

- **Surface passivation:** Passivation of the hydrogenated silicon surface after HF processing, with a thin protective oxide film can reduce contamination and minimize wafer surface micro-roughness. Studies have shown ozonated DI water can improve breakdown charge (QBD) performance, producing better results than SPM, APM, HPM or hot H₂O₂.
- **Wafer cleaning-removal of organic impurities:** Removal of organic impurities from wafer surfaces is critical for subsequent chemical processes and product performance/yield. Studies have shown ozone/DI water or dilute HF treatments can completely remove impurities caused by two organic additives (BHT and DBP) as well as surfactants added to developer in the lithography process and HexaMethylDiSilaxane (HMDS) photoresist primer.
- **Wafer cleaning-removal of metallic impurities:** Ozonated DI water has been found useful in removing metal impurities on wafer surfaces such as copper and silver, but ineffective in removing transition metals, aluminum, and alkaline earth metals. However, research has shown treatments that utilize both ozonated DI water and HF, have the ability to remove alkaline earth metals, Al and transition metal impurities.
- **Wafer cleaning-removal of particles:** Use of ozonated DI water alone to remove particles on the wafer surface is not feasible. Use of separated ozonated DI water and HF steps have shown to be efficient in particle removal, lowering pH value to a range with favorable zeta potentials for particle removal.
- **Photoresist stripping:** Sulfuric acid, and now sulfuric -ozone mixtures, are currently used in photoresist removal due to the speed and thoroughness of these agents. Ozonated DI water methods for photoresist removal are being developed to replace these chemistries, as they provide lower process temperatures and a decrease in the overall usage of DI water (with less dangerous processes). The ozone/DI water process has already been shown to remove of a wide variety of photoresists.
- **Applications of ozone in adjacent industries:** Solar cell manufacturing, an adjacent industry to semiconductor manufacturing, is also exploring the use of ozone. Cleaning and wafer preparation applications using ozonated DI water have been developed specifically for the use of silicon based solar cell

manufacture. The ozone DI water solutions are used as substrate cleaning steps, such as pre-cleaning to provide a suitable surface for etching and texturizing silicon surfaces[18], and processes that require both cleaning and surface passivation in the development of the cell.

- **Water ozonation using membrane contacting technology:** Membrane contacting technology is the preferred method used to inject ozone gas into water. A membrane contacting device is based on non-wetting gas permeable membranes, which act as a barrier between liquid and gas, and allow only gas diffusion through the membrane.

Entegris, as a leader in providing advanced solutions for the semiconductor, solar/energy and other high technology industries is participating in the development of such water ozonation contactors with its unique membrane contactor for gasification processes, the pHasor® II.

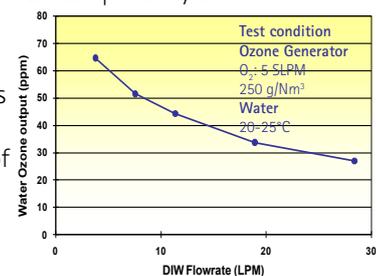


Entegris membrane contactor pHasor II

- ▶ The pHasor II membrane contactor has an ultra clean construction made entirely of perfluoroalkoxy (PFA), (hollow fiber membranes, end caps, fittings and housing with no o-ring) which has very low extractable and particles (< 50 µg on liquid side) and is also chemically compatible with ozone.

- ▶ The all PFA construction also allows the contactor to be used with almost any type of highly aggressive, oxidizing and corrosive chemistry, due to the high chemical compatibility of PFA.

- ▶ The pHasor II also has a large membrane surface area which enables for excellent gas transfer efficiency to rapidly produce high concentrations of bubble-free dissolved gas in process liquids, and also has excellent hydraulic performance with low pressure drops in its recommended operating range.



Entegris membrane contactor pHasor II has unmatched performance to produce high concentrations of bubble-free DI₂O₃ solutions at high flow rates.

Conclusion

A variety of industries are starting to employ ozonated water treatment, taking advantage of the technology's lower costs, ease-of-use and simplification of processes. However, due to its relatively new application in many processes, more research needs to be carried out to refine its application for efficient use. With the pHasor II membrane contactor, Entegris can provide a product and solution to enable these industries to effectively use and research ozonation for any application.

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Entegris to create advanced nanotech R&D and manufacturing center to support most demanding semiconductor manufacturing

By Entegris, Inc.

As smart phones, tablet computers, and other electronics become smaller, more powerful, and consume less energy, the technologies that are being employed to manufacture those devices are pushing the boundaries of physics.

Entegris is enabling those technologies by solving the most difficult purification, process control and material protection challenges in advanced semiconductor and electronics manufacturing.

Industry needs

Currently, semiconductor devices are manufactured using the most advanced processes and materials known to man and require levels of purity that measure contamination in parts-per-quadrillion (ppq). Achieving these precise levels of purity requires filtration solutions that can prevent nanolevel particles, bubbles and ions from reaching the semiconductor substrate during manufacturing. Polymeric membranes are the core material which is used to capture these contaminants. These solutions help advanced high-tech manufacturers improve productivity, performance and technology to develop next-generation semiconductors and electronics.

- The level of contamination control required for advanced semiconductor technologies is far more stringent than in any other industry. Other industries deal with particle sizes from the 20 – 200 nanometer range (bacteria is 200 nanometers and the smallest virus is 20 nanometers). Entegris' current line of filtration products helps control contamination from particles as small as 3 nanometers in size. This requires highly sophisticated and extremely advanced membrane filter manufacturing.
- For the next generation of semiconductor devices, the manufacturing environment must reach levels of purity that are measured in ppq. This means that the allowable level of contamination is one ppq, which is equivalent to one drop of water in an area the size of the entire Empire State Building.

Entegris nanotech R&D and manufacturing center



After a worldwide search for a premier location, Entegris will create the **Entegris i2M Center for Advanced Materials Science** ("i2M Center"), one of the world's most advanced centers for the research, development and manufacturing of

- ▶ filtration media technologies,
- ▶ electrostatic clamp (E-Chucks),
- ▶ proprietary, innovative low-temperature coating technologies.

These products are core components for filtration and purification solutions used in the most demanding high technology semiconductor and other electronic device manufacturing environments.

Entegris will invest approximately \$45 to \$50 million in building infrastructure upgrades and equipment over the next two years.

Facility Information

Address

9 Crosby Drive,
Bedford, MA (USA)

Size

Building: 80,000 sq ft
(25 000 m²)
Clean room space:
6,000 sq ft (2000 m²)

Number of employees

100

First operations start

January 2013

Entegris selected the Bedford site due to its proximity to the company's existing facilities and employee base, and access to highly trained materials science and membrane engineering talent.

"i2M" stands for "ideas to market" and represents the **focus of the new facility on innovation in the area of materials science.**

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New Impact® 8G: the latest photochemical filter generation down to 3 nm retention for ultra-purity delivery

By Entegris, Inc.

Impact 8G® photochemical filters provide industry-enabling solutions for critical lithography, efficiency and cost of ownership issues. With its unique core-fill design and asymmetric filtration media, the Impact 8G delivers **3 nm retention in a rapid-priming device that improves bubble clearance times to reduce chemical waste and downtime.**



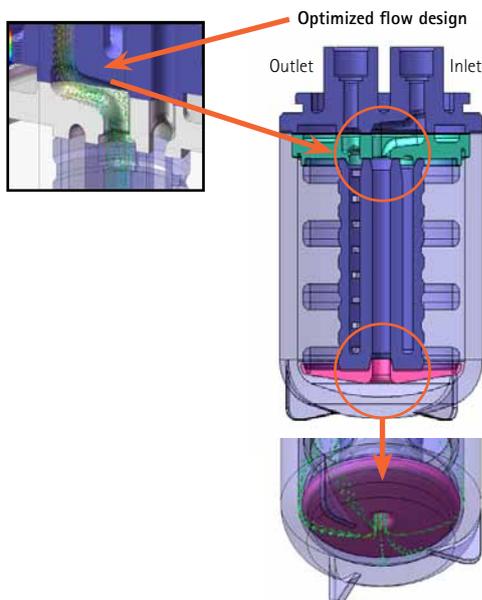
The Impact 8G photochemical filters represent years of customer intimacy, partnerships and in-fab production experience with customers struggling to enhance and refine their processes while improving overall operation efficiency.

Impact 8G filters reduce cost of ownership for existing process lines and enables emerging critical processes in POU lithography filtration for photoresists, BARCs, TARCs, solvents, underlayers, EUV lithography and emerging chemistries.

Delivering ultra-purity and retention down to 3 nm

Impact 8G filters provide ultra-clean filtration by use of a unique asymmetric filtration membrane that is aggressively cleaned during the manufacturing process to ensure low metal and organic extractable filter contribution. These ultra-low metallic and organic filters meet the requirements of the most demanding production and R&D environments.

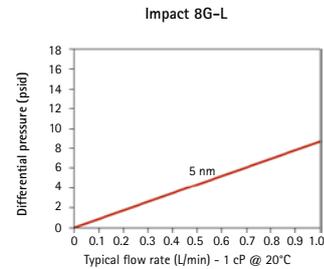
Fig. 1: Core fill structure



Superior performance and retention

- Unique and patented membrane technology down to 3 nm reduces on-wafer defects
- Asymmetric membrane with tighter retention and lower pressure drop performance
- Optimized core fill flowpath specifically designed to enable reduce priming/degas time
- Rapid changeout with no tools
- Available with RFID enabled

Fig. 2: Performance data



Features	Benefits
	Reduces overall filter priming time, reducing filter startup costs
Core fill structure	Efficient priming provides a more rapid return to a stable, repeatable production environment with lower defectivity
Low-metal raw materials	Ultra-clean filter construction and an aggressive metal reduction cleaning process reduces filter metals contribution
Low organic extractables	Aggressive organic reduction cleaning process reduces filter organic extractables
3 nm and 5 nm retention	Targets sub-40 nm technologies

Conclusions

The Impact 8G has been developed to address customer's critical needs in Lithography

- ▶ Filter start up
- ▶ Defectivity
- ▶ Filter cleanliness

Available in multiple configurations, the Impact 8G is the universal solution for POU lithography filtration.

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A comparative study of the HF sorption and outgassing ability of different Entegris FOUF platforms and materials

By Paola Gonzalez Ph.D., Engineer Application Development | CEA-LETI Assignee - Entegris Europe

FOUF (Front Opening Unified Pod) polymers are able to absorb airborne molecular contaminants (AMC) coming from the connection to equipment or from the release of just processed wafers and later outgas these contaminants. In consequence this subsequent outgassing of species trapped in plastic containers constitutes an important issue to wafer environmental contamination control. This molecular cross-contamination chain was clearly shown to lead to detrimental impacts in IC manufacturing, especially related to volatile acids. Among these species, HF cross contamination has been identified as a root cause of Cu, Al or poly-Si corrosion as well as TiFx crystal growth on TiN layers.

▶ In this note we report on a comparative study of different FOUF platforms (under the frame of Leti-Entegris collaboration) composed of different polymer materials in order to quantify their ability to be contaminated by HF and to subsequently release this molecule. **Our purpose was to assess the different FOUF polymers in terms of potential cross-contamination risks to stored AlCu-wafers.**

FOUFs and polymers materials tested

The five containers tested were new commercial Entegris FOUFs composed of six different polymers, see table hereafter:

FOUF tested	FOUF platform	Shell material	Wafer capacity	Side columns material	Inner door material	Wafer planes material
EBM/CNT	A300™	EBM/CNT	25	EBM/CNT	EBM/CNT	EBM/CNT
EBM	Spectra™	EBM	25+1	EBM	EBM/CNT	EBM/CNT
PC	Spectra™	PC	25+1	PC	PC/CP	PEEK/CF
PC/CP	Spectra-S™	PC/CP	25+1	PC/CP	PC/CP	PEEK/CF
PEI/CNT	Spectra™	PEI/CNT	25+1	PEI/CNT	PEI/CNT	PEEK/CF

EBM: Entegris Barrier Material
 CNT: Carbon-nanotubes
 PC: ultrapure polycarbonate

PC/CP: STAT PRO® 500 carbon filled PC
 PEI: polyetherimide
 PEEK/CF: carbon fiber polyetheretherketone

Experimental

To study the FOUFs contamination/outgassing by HF, an intentional contamination protocol was simulated in a new FOUF.

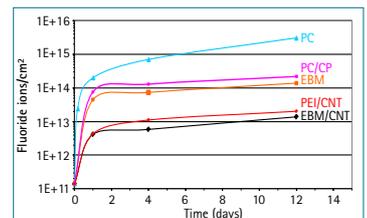
- Step 1: A microdroplet of diluted HF (placed in a PTFE cup) was introduced for 24 hours into the FOUFs until its total evaporation.
- Step 2: A 5 minute purge step was performed with a nitrogen gun.
- Step 3: In order to show the subsequent release of HF and the transfer from FOUF to substrates, 200 mm silicon wafers with aluminum layer (650 nm of Al-0.5 % Cu alloy) were intentionally exposed inside contaminated FOUFs using specific supports (Entegris modified cassettes) for up to 12 days.
- Step 4: As a control measure, one 200 mm AlCu wafer was set into not contaminated FOUFs for 12 days.

HF concentration in exposure air was checked by impinger in ultrapure water (UPW) and analysis of the trapping solution by ion chromatography (IC). In consequence, acids are quantified in their anionic form (as halides). Acids deposited on wafers were collected by a liquid phase extraction (LPE) of the surface using an UPW low-volume and were also determined by IC. The LPE-IC enabled quantification of acidic species with low limits of detection better than $5E+11$ ions/cm².



Results

Contamination profiles over time are characterized by a strong increase in the first 24 hours followed by a slower growth, as the general trend previously reported for the HF deposition kinetic on AlCu-wafers.



The cross contamination of HF over AlCu storage wafers, clearly shows also three behaviors, namely:

- a very low increase of HF concentration on AlCu-wafer in the case of EBM/CNT and PEI/CNT (lower than 4.3×10^{12} ions/cm² after 24 hours exposure),
- a moderate increase in the case of the EBM and PC/CP (4.5×10^{13} and 7.6×10^{13} ions/cm²)
- and high levels in the PC FOUF (2×10^{14} ions/cm²) at the same 24 hours.

This means that the transfer of HF from FOUF to wafer occurs by molecular outgassing. As this process is governed by the equilibrium between HF concentration in the air and in the FOUF material, these results characterize the differences of HF outgassing intensity, higher outgassing leading to higher wafer contamination.

Conclusion

Results show that **EBM/CNT, PEI/CNT and EBM materials are good FOUF polymers to diminish defectivity issues associated to HF volatile acid in link with their low wafers cross contamination ability.**

Indeed EBM/CNT and EBM with PEI/CNT have interesting release potentials (lower for EBM/CNT and PEI/CNT and moderate for EBM) enables to fulfill ITRS recommendations for exposed AlCu wafer over 24 hours storage time.

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Product and Service Highlights

New Aeronex® AGPS purification system: the solution for highest quality XCDA purity

Aeronex gas purification system

The Aeronex® Gas Purification System (AGPS), HX series, is the latest continuous service high-flow gas purification system from Entegris. The system brings advanced technology to high-flow gas purification providing semiconductor manufacturers with an innovative, efficient and cost-effective solution to purify photolithography purge gases to protect optics and other critical surfaces.



The new "HX" media represents the latest advancement in purification technology from Entegris, providing for outlet purity in the sub parts-per-billion (ppb) and parts-per-trillion (ppt) levels - for more details please refer to the article of the previous edition, *Zero Defects Volume 10 Issue 4*.

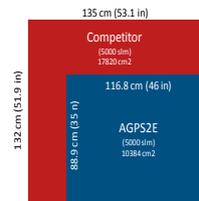
The system applies ambient temperature purification, so heating is not required for purification. This means resource conservation and lower energy costs. The AGPS effectively and efficiently removes contaminants such as H₂O, O₂, CO, CO₂ and nonmethane hydrocarbons from hydrogen or nitrogen gas.

Why will you prefer Aeronex gas purification system?

- ▶ Systems designed to **maximize purified gas uptime**
- ▶ **Higher wafer yield**
10 times cleaner on 4 out of 6 critical contaminants

Features	ENTG Spec	Competitive Spec
Volatile Bases	< 10 ppt	< 10 ppt
Volatile Acids	< 1 ppt	< 10 ppt
Condensable Organics	< 1 ppt	< 10 ppt
Refractory Compounds	< 1 ppt	< 10 ppt
Moisture (H ₂ O)	< 100 ppt	< 100 ppt
Particles	Entegris Wafergard Filter - ISO Class 1	None standard

- ▶ **42% footprint savings with lowest facility costs**



Entegris services to optimize uptime, cost and environmental awareness

Entegris is always looking for the best support to its products and customers. To achieve this, multiple ways are possible, with new products, better response times, reduced CoO, or for example by creating service packages, which help you to focus on your core competency - chip manufacturing.

The packages are not only reducing the risk of a possible component failure or even a tool down time, they are removing completely the need to think about the system as when/which maintenance activity, order of spare parts and estimation of consumable needs. Entegris is taking care of everything and alerting you on the upcoming schedule and arrange the right time, when the tool is available according to your schedule.

Entegris has developed 3 standard service offerings dedicated to gas and liquid systems.



Warranty extension

- Up to additional 24 months of coverage
- 4 hours call back during standard working hours
- Local phone support during standard working hours
- On site response less than 3 business days

Maintenance package

- All consumables for the system
- Inspection of system performance during maintenance
- Regular service visits per maintenance schedule
- Management of consumables supplies
- All labor and travel costs for maintenance activities
- Coordination of maintenance schedule
- Documentation of all maintenance activities

Full service package*

- System evaluation at the beginning of the contract
- Regular service visits
- Local phone support during standard working hours
- All labor and travel costs
- 4 hours call back during standard working hours
- Documentation of all activities
- On site response less than 3 business days
- Inspection of system performance days
- Coordination of maintenance schedule
- Management of consumables supplies
- All consumables for the system
- Replacement of failed components

Prevent your productivity and yield, by the right service contract to mitigate your risks.

→ Contact: europe_region@entegris.com

* for out of warranty LiquidLens system

ZERO DEFECTS

Europe Newsletter

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