

Zero Defects..

The Entegris Newsletter

Volume 8 – Issue 4
Europe Edition
January 2010

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Publisher: Entegris Europe

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Entegris @



The 26th European Mask and Lithography Conference takes place at the Minatec Conference Center in Grenoble, France from the 18th to the 20th of January 10.

This conference brings together scientists, researchers, engineers, and technologists from research institutes and companies from around the world to present innovations at the forefront of mask lithography and mask technology.



Entegris will be part of the technical exhibition and will present the unique Clarilite® reticle haze prevention solution and the development/availability of an EUV reticle handling solution. ■

Responding quickly, Entegris designs a reagent fill subsystem in five days

While launching a new reagent, a major specialty chemical manufacturer approached Entegris for a surge tank manifold distribution subsystem that offered both high purity and corrosion resistance.

Responding quickly with custom fabrication capabilities, a broad range of fluid handling products, and knowledge of Biopharm processes, Entegris designed the complete subsystem



Entegris 2010 tradeshows calendar

18 - 20 January	EMLC – 26th European Mask and Lithography Conf. and Exhib. Grenoble, France
2 - 5 March	AABC – 1st Advanced Automotive Batteries Conf. and Exhib. Mainz, Germany
27 - 29 April	Photovoltaic Technology Show Stuttgart, Germany
14 - 16 June	Semicon Russia Moscow, Russia
6 - 10 September	25th EU PVSEC – European Photovoltaic Solar Energy Conf. and Exhib. Valencia, Spain
19 - 22 September	10thUCPSS symp. – Ultra Clean Processing of Semiconductor Processes Oostend, Belgium
28 Sept. - 01 October	Glasstech Düsseldorf, Germany
19 - 21 October	Semicon Europa Dresden, Germany
1 - 4 December	Euromold Frankfurt, Germany

from concept to signed assembly drawings in five days.

The solution utilized existing

- Cynergy® sanitary products,
- CR8 valves,
- FluoroPure® chemical containers,
- a custom manifold,
- and fabrication services delivering a flow distribution system with reliability, performance, and control while meeting clean-in-place and cGMP requirements. ■

Spectra™ FOUN technology advancements FM4911 certified SPECTRA and optimized purge gas distribution

By Holger Walther - Application Engineer, Entegris Europe

Entegris now offers several new enhancements to its 300 mm Spectra™ FOUN.

These include a new FM4911 approved FOUN made with a **new material** for reduced risk of fire and smoke propagation in the fab and new, **revolutionary snorkel technology** to allow for a dramatic reduction in purge time and gas distribution.



Spectra FOUN

FM4911 Approved Spectra™ FOUN

Spectra FOUN's, as tested, meet requirements for use at any location within a clean room as described in the FM approval standard for wafer carriers for use in clean rooms.

The FM4911 approved FOUN does lower the risk for smoke propagation and flammability. This has significant impact for users, including:

- Reduces insurance premiums due to reduced risk of fire
- Lowers fire suppression requirements for new fabs (reduces capital equipment costs)
- Reduced total risk reduces total amount of insurance required
- Lower total risk may allow for fewer insurance providers per facility
- Spectra is the only FM4911 approved FOUN on the market

The FM4911 FOUN is available in a variety of colors including red, green, orange, and ESD black.



FM test for flammability



Purge gas distribution improvements for the SPECTRA FOUN

New snorkel technology addresses some of the shortfalls of previous generations of purgeable FOUN's. It is very critical to reduce moisture and other outgassing constituents to an acceptable level in a very short period of time in a clean microenvironment. There are several constraints to overcome. The 25 wafers in a FOUN are a mechanical resistance against the gas flow and to gas distribution within the FOUN. The velocity of the gas purge must be limited to avoid turbulence within the FOUN that could lead to unwanted particle generation and wafer movement.

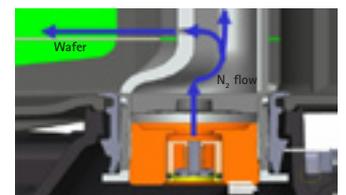
With the new snorkel diffuser technology, purge gas is guided between the wafers and equilibrium is achieved in a significantly shorter period of time at the same flow rate. As a result, unwanted chemical reactions at the wafer level can be avoided.

The purge snorkel diffuser system has the following advantages for the user:

- SPECTRA FOUN's can be easily retrofitted in the field on purge-capable FOUN's
- The diffuser snaps into the existing purge location
- Diffusers distribute purge gas more homogeneously between the wafers
- Gas equilibrium is achieved much faster



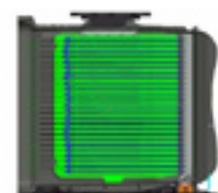
Purge time reduced



Gas flow is faster



Snorkels easily replaced in the field



Gas flow is more homogenous

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Entegris wins a 2009 EuroAsia Semiconductor Magazine IC industry award

Entegris, Inc.

At the 2009 Semicon Europa tradeshow in Germany, Entegris received the 2009 EuroAsia Semiconductor award.

The IC Industry Awards are a recognised platform that focus on the people, processes and products that drive the industry forward.

What makes these awards unique in the microelectronic industry is not simply that the winners were decided by those that use the tools but that it demonstrates positive relationships between tool and service providers and their customers.

Product outline

Torrento is a family of high-flow liquid filters that help improve liquid contamination control of nano-scale particles in wet etch and clean (WEC) manufacturing processes used in advanced semiconductor applications.

Built on a combination of new membrane technology and an advanced ATE device construction, the Torrento filters provide:

- high-yield,
- rapid bath clean-up cycles,
- extended filter life, and allow for fast change-outs and increase cleanliness.

Problem

As semiconductor manufacturers drive their sub-45nm technology applications, contamination control becomes increasingly more difficult.

The filter retention is extremely critical as the purity of the chemicals used in WEC can directly correlate to wafer yields.

To remove increasingly smaller contamination particles, wafer fabricators found themselves using filters with smaller pores, which forced reduced filter flow and ultimately slowed wafer processing speed.



Torrento® filters

Solution

With the Torrento high-flux platform of WEC filters, semiconductor manufacturers can maintain ultra-high flow rates without sacrificing chemical purity at the 20nm rating.

That's because the Torrento 20nm filters use a specialized nondewetting Teflon membrane technology. Torrento filters also have a larger surface area than general use filters due to an advanced ATE device construction technology.

The combined effect is a filter that allows manufacturers to:

- reduce particle-related wafer defects,
- decrease process cycle time,
- and increase filter life.

The low filter resistance also is designed to reduce pump strokes and decrease wear and tear.

Applications

The capability to maintain flow rate at an extremely small pore size in outgassing chemistries such as SPM, SC1 and SC2 ensures the stable processing conditions needed for the high CpK results demanded at advanced technology nodes.

Platform

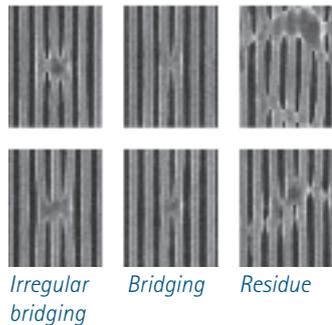
Torrento filters are available in cartridge and disposable formats to accommodate installation flexibility and upgrades. The disposable filter eliminates operator handling of the filter element, further minimizing contamination risk. The disposable design also reduces the potential operator exposure to chemicals during installation and disposal. ■

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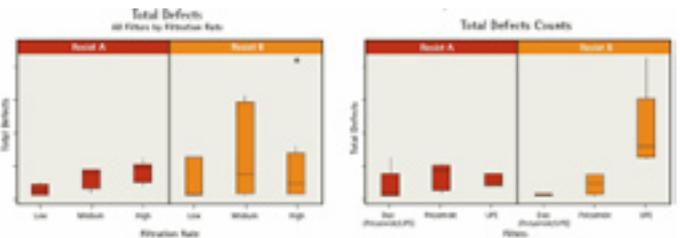
Defectivity investigation with point-of-use filtration parameter changes

By Jennifer Braggin, Photodispense Applications Development Engineer, Entegris Inc. and IMEC Assignee and Wim Schollaert, Xavier Buch, and Kenji Hoshiko, JSR Micro N.V.

While many of the defect challenges facing lithographers using immersion lithography have been tackled, a few familiar defects from dry lithography, such as microbridging and residues, are still present in immersion lithography processing with topcoatless resists. Although these defects are not new, their existence on ever-shrinking patterns causes alarm when driving towards challenging yield targets.



For both resists, the Duo filter provided the lowest ultimate level of defectivity. More importantly, the Duo filter was best able to control defect fliers in Resist B.



Study

In this study, the effect of point-of-use filtration and filtration parameters were studied to understand their effect on immersion defectivity levels with topcoatless resists.

The effect of filter choice, including membrane design and material, is one important factor in reducing defectivity.

In this study, three Entegris filters were chosen with a retention rating of 10nm. Those filters specifically chosen were Impact® ultra-high molecular weight polyethylene (UPE), polyamide, and Duo filters. The Impact® Duo filter combines a UPE membrane with a polyamide layer to maximize the sieving and non-sieving capabilities to address advanced defectivity issues facing today's challenging lithography landscape.

In addition to studying different filter membranes, filtration settings were also considered.

Special attention should be paid to filtration settings, as the setting can greatly affect defectivity levels. Poorly optimized filtration settings can needlessly increase defect levels.

Experimental

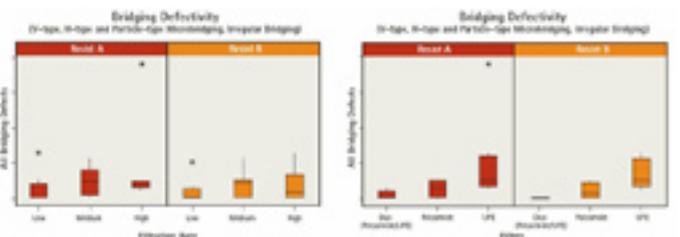
The resist stack for this experiment consisted of 95nm BARC and 105nm of two different JSR resists. These resists were delivered expecting to drive different interaction between filter media and resist itself. All wafers were coated and exposed on the Sokudo® RF3Si/ASML 1900 Gi cluster at IMEC in Leuven, Belgium. A 45nm line/space defectivity mask was used for the exposure.

Results

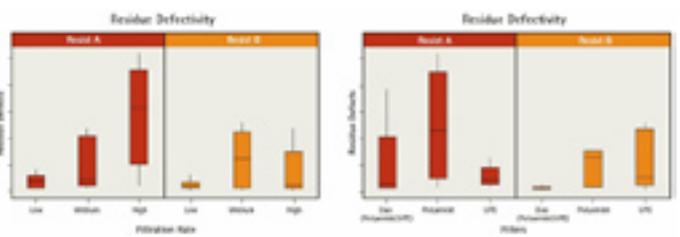
For total defect levels, the effect of both filter choice and filtration setting can be seen. Total defect counts are modulated directly by filtration rate for Resist A. The trend is not as clear for Resist B, which had overall higher and varying levels of total defectivity.

Aside from total defects, two specific defects were explored.

Microbridging defects are one of the biggest challenges to lithographers today. For this specific defect, the low filtration rate again showed the best performance for both resists. The microbridging defects were also best mitigated by the Duo filter, using the combined sieving and non-sieving properties of the combined UPE membrane and polyamide layer.



Residue defects were similarly studied. Here, the low filtration rate did not have a significant impact on residue defects, but the low filtration rate was able to best control the variability of this defect type. In the case of filtration, the UPE membrane was best able to control residue defects in Resist A, and Resist B had the best performance with the Duo filter.



In conclusion, understanding point-of-use filtration is important when trying to drive to low defectivity levels. It is critically important that lithographers optimize filtration settings as well as choose the right filter for the right application. As has been shown, the correct filtration setup, combined with the right filter for the right application, can help reduce overall defectivity and target specific, important defects. ■

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Controlled DI water gasification for advanced semiconductor cleaning processes

By Annie Xia, - Applications Engineer, Liquid Systems, Entegris Inc.

Driven by continually shrinking feature sizes and adoption of ever more fragile materials in IC manufacturing, it has become crucial to develop effective and low impact processes that are benign to features on wafers. Recently, trends towards dilute chemistries and progress in megasonic cleaning have brought renewed interest in gasified DI water.

Typical high purity water gasification applications

The following list illustrates some of the novel wet clean applications involving various gases dissolved in high purity DI water:

- Organic removal with ozone-DI water
- CO₂-DI water rinsing to eliminate static charge on wafers
- Megasonic particle cleaning with N₂-DI water, H₂-DI water
- pH adjustment with CO₂- DI water, NH₃-DI water
- Corrosion control in BEOL cleaning with CO₂-DI water
- Photomask (including EUV mask) with ozone-DI water, H₂-DI water and CO₂-DI water

Entegris pHasor® II membrane contactor

Entegris' phasor II membrane contactor all PFA (PerFluoroAlkoxy) is the ideal solution to deliver bubble-free gasified DI water.

The pHasor II contactor is fabricated using all PFA hollow fiber membranes, potted into a PFA shell using PFA resin, then completed with PFA end caps. The hydrophobic membrane allows gas to freely diffuse into water, but prevents water from passing through the membrane into the gas side.



Entegris All PFA pHasor® II Membrane contactor

Compared to conventional polypropylene based contactors, this all-PFA O-ring-less design delivers superior purity and chemical capability, allowing the device to be used with a wide variety of fluids and gases for various applications.

Feature	Benefit
Large membrane efficiency	<ul style="list-style-type: none"> • Enables excellent gas transfer surface area • Rapid production of high concentrations of bubble-free dissolved gas in process liquids
PFA hollow-fiber membrane	<ul style="list-style-type: none"> • Provides quick response during system startup • Delivers high dissolved gas concentrations • Delivers low pressure drop over the fluid paths
All-PFA shell construction	<ul style="list-style-type: none"> • Provides excellent chemical compatibility • Ensures chemical cleanliness • Beneficial in critical cleaning applications
Fluid Flow design	<ul style="list-style-type: none"> • Eliminates boundary layer effects and maximizes efficiency • Low fluid pressure drop to minimize downstream outgassing

Entegris automatic water gasification system – the complete system solution for controlled gasification

Advanced cleaning steps demand a broad range of water flow and fast flow rate changes. It is important to maintain a stable dissolved gas concentration to ensure a non-disruptive and stable process.

Entegris has designed an automatic gasification system that incorporates its pHasor II membrane contactor and an optimized PID control loop to maintain the dissolved gas concentration to a customer-specified set point as process flow changes. The system is equipped with gas and liquid flow controllers, a dissolved gas sensor and other automated features to reduce system maintenance and downtime. Its unique patent-pending direct gas injection method minimizes gas and fluid consumption as well as system complexity.

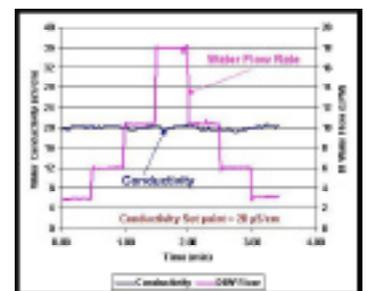
Figure 2 is an example of Entegris' stand alone automated CO₂-DI water gasification system. An in-line conductivity sensor measures the amount of CO₂ in water since the concentration of CO₂ in water is directly proportional to water conductivity. As water flow rate changes, the system's control loop continuously adjusts the amount of CO₂ injected into DI water based on the feedback from the conductivity sensor until the measured dissolved CO₂ concentration (conductivity) matches the set point.



Fig. 2: Entegris automated CO₂-DI Water Gasification System

Figure 3 illustrates how the system is able to control the conductivity within ± 5% as water flow rate changes from 3 to 18 LPM.

Fig. 3: Conductivity (dissolved CO₂ in DI water) vs. Time as water flow rate changes 30 seconds between 3 – 18 LPM (Conductivity set point = 20 µS/cm; water temp. = 24°C)
Dissolved CO₂ concentration is directly proportional to water conductivity



The system's quick response and wide operating range make it an ideal solution for applications where gas concentration needs to be controlled, yet process recipe demands variable fluid consumption.

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Fluorescence Spectroscopy (FS) Sub-30 nm retention test method

The benefits of chemical filtration in the production of semiconductor devices have been well accepted by the industry for several decades.

As the technology has evolved, increasing contamination control requirements have driven the need to upgrade filtration to remove particles measuring 30 nm and smaller.

Traditional approach

Traditional optical particle counting techniques used to measure particle removal efficiencies have not kept space with the industry's requirements for tighter filtration and reproducible retention ratings. Novel techniques for measuring filter particle retention are needed to meet the demands of the microelectronics industry.

New Entegris test method

Entegris is sharing the highlights of this new testing method to demonstrate the improved accuracy of our sub-30 nm retention ratings on liquid filters.

- ▶ The method has been developed and refined over several years resulting in an accurate and reproducible way to measure particle removal efficiencies for sub-30 nm pore size rated filters.
- ▶ The method uses a fluorescence strength signal as emitted by fluorescent dyed particles. There are several advantages to the fluorescence method compared to traditional OPC techniques. A significant advantage is that the fluorescence method has no inherent particle size limitations; it is only limited by the availability of the fluorescent particles.

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Your request / Feedback

We welcome your feedback and suggestions to improve Zero Defects. Please send them to europe@entegris.com or fax us at +33 (0)4 76 35 73 02

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