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Entegris announces technology collaboration with IBM

Joint development agreement focused on yield enhancement technologies for advanced semiconductor processes

BILLERICA, Mass. – February 24, 2011 – Entegris, Inc. (NASDAQ: ENTG) announced today a joint development agreement with IBM (NYSE: IBM) to develop and test new filtration techniques for use in advanced semiconductor manufacturing.

The collaboration will focus on generating test data off of a new generation of Entegris filters and dispense systems that are used to dispense and filter imaging materials as part of the photolithography process in a semiconductor fab. Entegris, which is the only provider of both filters and dispense systems used for this application in the semiconductor industry, will work with IBM's technology team in East Fishkill, New York to develop new

technologies for controlling impurities such as particles and bubbles that can negatively impact manufacturing yields. The use of new materials, process chemistries, and photolithography techniques are presenting new challenges for the semiconductor industry as it develops technologies to manufacture next-generation chips that are smaller, more powerful, and which consume less power.

Gideon Argov, president and CEO of Entegris, said: "This agreement complements the work we have been doing with other industry consortia to **demonstrate the benefits of effective filtration on process yields in sub 32-nanometer node semiconductor manufacturing.** We are delighted to be able to partner with one of the technology pioneers in our industry."

Entegris seminar Israel, May 3-4



Entegris organized a seminar in Israel focusing on **purification, filtration and fluid handling for industrial & life science.**

This event took place in Tel Aviv on the 3rd and 4th of May 2011.

Filtration and Purification May, 3 rd	Fluid Handling May, 4 th
Filtration basics	Materials of construction
Filter selection guide	Fluid handling process systems
Gas filtration	Products/application
Gas purification	Levitronix® Pump

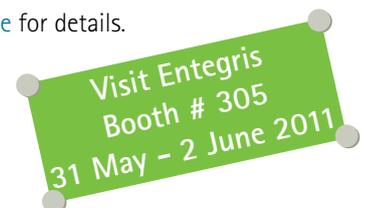
→ Contact: europe@entegris.com

Entegris @ Semicon Russia

Semicon Russia main focus in **SEMICON Russia 2011** is the further development of the Russian semiconductor and photovoltaic industry.

Come and visit Entegris booth to be informed on advanced and innovative solutions to reduce your costs, stabilize your process and improve your yield.

Click [here](#) for details.



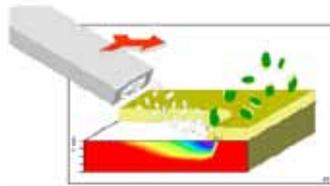

creating a material advantage

Cost Reduction

Decontamination with cryogenic process

By David Cheung - R&D Engineer, Entegris Cleaning Process (ECP)

Entegris Cleaning Process (ECP) has recently implemented a new process of decontamination, based on the cryogenic properties of carbon dioxide. CO₂ pellets are sprayed under high pressure and used as surface treatment in order to remove specific soils. CO₂ spray process is largely used in common industries to remove mainly organic residues (oils, greases, hydrocarbons...) on parts coming from manufacturing processes. ECP identified a new application using that technique: deburring or flash removal. The process is particularly effective on plastic parts that present burrs or flashes coming from polymer injection or machining. Assessments have also been performed on photovoltaic and semiconductor carriers, which lead to very positive and encouraging results for the removal of visible contamination on PFA carriers.



Methodology

The dry ice or sticks, at a low temperature of -78°C, are projected from the spray gun with a pressure between 2 and 15 bars to the contaminated surface. During the impact 3 physical phenomena are happening:

- The dirtiness under cold effect is weakened and becomes breakable.
- the sticks are transformed from solid to gaseous state, a step called 'sublimation', the volume of CO₂ raising around 500 times, these micro explosions optimize the mechanical action of cleaning.
- The mechanical action of the ice removes the dirtiness.

Advantages of the process

- ▶ **Low cost of cleaning**
 - Fast cleaning allowing employee's working hours reduction
 - Less waste to manage
 - No drying time, the production tool is clean and immediately available
- ▶ **Quality improvement**
 - Better quality of finished products
 - Better productivity
 - Integrity of the support compared to sand-blasting or any mechanical process
 - Completely dry process: no electric or mechanical issues
- ▶ **Environment protection**
 - Chemical pollution elimination by using CO₂ captured in the atmosphere
 - No waste created during the process

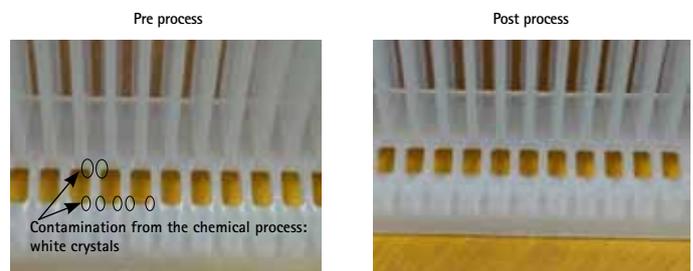
▶ Employees security

- No risk of injury usually provided by dangerous solvents or chemical cleaning products.

Applications

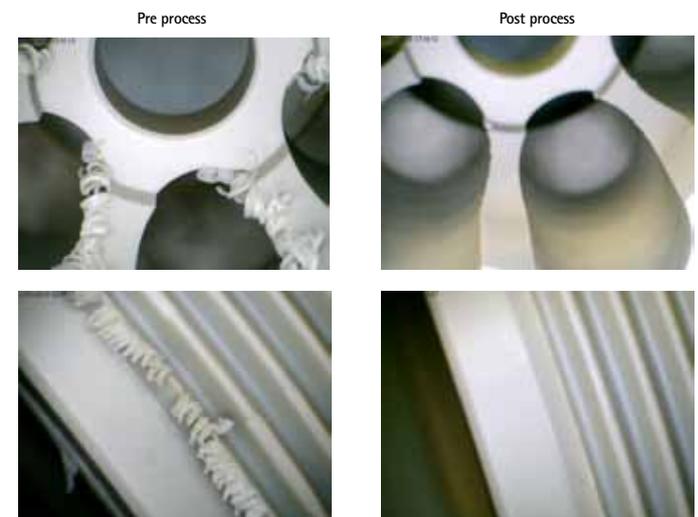
- Removal of burrs and flashes due to polymer injection or machining (plastic, PFA, PEEK...)
- Removal of organic contamination on parts without damaging the surface

Example of a carrier used in SC or PV industry



- The scratches and burrs due to an intensive use are mostly removed
- The white contamination due to chemical process crystallization is completely removed

New injected parts (Teflon®) with burrs



- The burrs left by the machining process are completely removed after cryogenic spray

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Process Stability

Slurry dispense optimization with the SL10 flow controller

By Shane Collis - Application Engineer, Entegris Europe

The SL10 is a point of use flow controller which is specifically developed for critical slurry dispense in CMP tools.

This latest slurry flow controller is based upon Entegris industry leading and proved liquid flow controllers, using a highly accurate differential pressure flow measurement technology, but with a flow path that is slurry friendly.

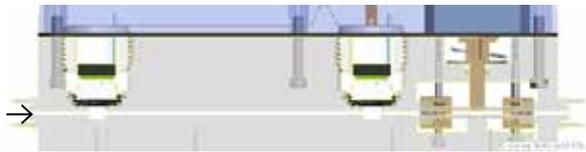


SL10 flow controller

SL10 features

▶ The SL10 is designed so that it has a straight through flow path, which has no bends or flow restrictions which can generate fluid shear. To maintain the straight through flow path, it uses a pinch valve design to **reduce agglomeration, minimizing the risk of polishing defects and improving yield** during the CMP process. The SL10 is perfectly placed to solve slurry health, accuracy or high maintenance problems of older slurry flow control technologies.

SL10 flow path



▶ Calibration of the flow controller is enhanced by the use of a field calibration tool. The calibration tool is windows based which enables one time characterization of the flow controller with any custom slurry blend. Known values for density and viscosity are not needed.



SL10 Field calibration software

Data points are collected at 10% increments and then used to generate offset coefficients. The coefficients are then uploaded to the SL10 flow controller and stored for each slurry blend.

Experience @ imec

 In 2010 the SL10 was installed at many sites including IMEC in Belgium. At this site it was used to replace an older peristaltic pump and rotor-meter configuration on a 200 mm CMP tool which was using a Tungsten slurry. The upgrade replaces the peristaltic pump in the slurry drawer with the SL10 flow controller and removing completely the rotor meter unit. Electrical installation is placed inside the tool electrical cabinet and

configured so that it is a drop in replacement of the peristaltic pump.

By replacing the peristaltic pump, which generally has inaccuracy worse than 15% and is difficult to maintain to tolerance below 180 ml/min, IMEC are able to **achieve a higher degree of flow accuracy**, the accuracy of the SL10 is specified as +/-1 Full scale flow. During flow verification tests during the installation, flow was seen to be well within this specification.

SL10 benefits

- **Particle generation reduction** due to a pinch valve across a perfluoroelastomer tube to regulate flow.
- **Flow inaccuracies removal** through an automatic re-zero calibrations every time a slurry dispense cycle has completed.
- **Better identification of leaks , slurry supply problems, external valve issues in the upstream or downstream flow path** through onboard alarms that can be set for high/low pressure and high/low flow.
- **Improved tool availability by reducing maintenance cycles.** Since the replacement of the peristaltic pump at IMEC, the SL10 has required:
 - no maintenance
 - no recalibration
 - no interventionWhile adjacent peristaltic pumps have since had 3 maintenance visits due to tube failure, and 3 subsequent calibrations.
- **No failure after 3 million cycles** (with a target of 5 million) of the Entegris in house pinch valve cycle testing monitoring leakage, using nitrogen at 60 Psi with a cycle open/closed every 10 seconds.

Conclusion

IMEC will explore to reduce the slurry consumption of the tool using the SL10 flow controller, by enabling the recipe parameters to be set to a lower level. The level has been set by using historical calibration data of the peristaltic pump to identify the lowest flow rate when process parameters were comprised. By using this flow rate with the flow controller, IMEC can run lower dispense levels without compromising the process.

Although yet to be verified on a second system, **the flow controller has a higher degree of accuracy and a better level of consistency over time.**

Acknowledgement to:
Peter Leunissen, Hans Van Horebeek from IMEC
Shane Collis Entegris, Inc.

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Yield Improvement

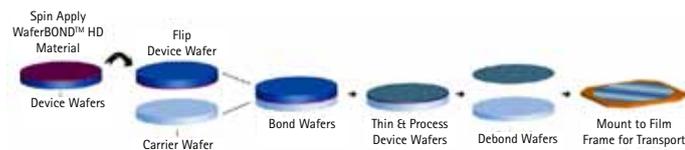
Benefits of dispense and filtration controls in wafer bonding applications with IntelliGen® HV

By Andy Miller - Team Leader Litho MTM, IMEC

Jennifer Braggin - Sr. Applications Engineer Manager and Sophie Bernard - Entegris Assignee at IMEC, Entegris, Inc.

Device performance, when measured in terms of size, power consumption and speed is a key metric for all semiconductor manufacturers working in the mobile technology, computer and image sensor space. 3D integration technologies are becoming a major focus to increase performance without increasing footprint. These technologies require the use of thin to ultra-thin wafers in order to enable Through-Silicon-Vias (TSV) interconnects between stacked devices.

These thin wafers are very flexible and fragile and can't be processed without rigid support. Therefore, thin wafers are temporarily bonded to carriers to allow further manufacturing and processing. One simple way to create the bonding between a carrier and a wafer is to use a temporary adhesive material, such as Brewer Sciences' WaferBOND™ HT 10.10.



Objectives and applications constraints

The coating of bonding materials on wafer carrier should be as uniform as possible without particles or air bubbles. Particles and bubbles can create local areas of non-uniformity, and this will affect further processing and could lead to negative yield impact. In the following study we will look at the benefits of dispense and filtration controls in this deposition process.

A dual stage IntelliGen® HV dispense system has been installed on a Süss MicroTec Delta 80 manual spinner. Waferbond HT10.10 material was dispensed onto 200 mm Si wafers with a targeted thickness of 16.5 µm. Results of different coating techniques were compared:

- Manual Dispense
- IntelliGen HV dispense without filter
- IntelliGen HV dispense with filter



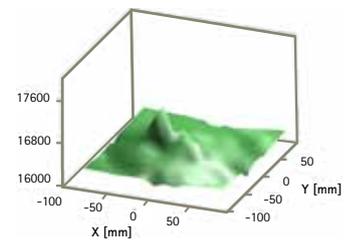
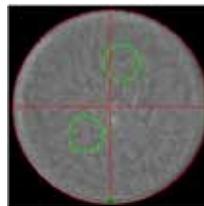
The IntelliGen HV has been designed to work with chemical viscosities ranging from 100 cps to 20000 cps based on Entegris' patented two-stage dispense technology. Unlike single stage dispense technology systems two-stage dispense technology allows the separation of the dispense step from the filtration step. **This is a key differentiation to ensure a constant and repeatable dispense free of defects.**

In addition, IntelliGen HV can control filtration rate and filtration pressure allowing the user to tune his process for optimal defectivity results.

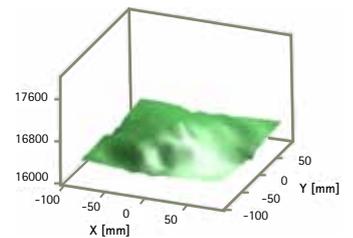
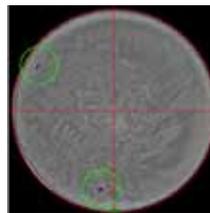
Experiments results

Coating uniformity was checked on a Senduro Automatic Reflectometer. Wafers inspections were performed with a NandaTech Spark.

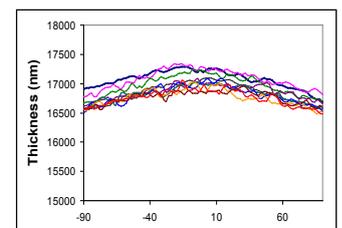
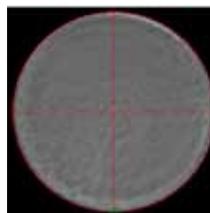
Manual dispense



Pump without filter



Pump with filter



Conclusions

The best results were obtained with the use of the pump with filter at low filtration pressure and low filtration rate. The use of filter can reduce level of deposited bubbles and prevent any incoming air to pass in dispense line. The introduction of the IntelliGen HV system shows Entegris' continued focus on developing new products to meet changing industry needs and applications.

Acknowledgement to:

The IMEC LithoMTM bonding and assembling group at IMEC
Andy Miller, Valery Pepper, Fabrice Duval from IMEC
Sandlip Helder from UCP group in IMEC

Sophie Bernard, Jennifer Braggin, Paul Magoon Entegris, Inc.

Brewer Science

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New Products

New Entegris PFA fitting: PrimeLock™ introduction

Entegris has launched our new PFA fitting technology, PrimeLock™. This technology is key to protecting our customers critical process chemistries.

▶ Transferring chemicals from point A to point B safely, reliably and without compromise. It's one of the ways Entegris creates a material advantage for our customer.

One of the basic building blocks of a PFA fluid handling system is the fitting.



PrimeLock fitting family

The fitting choice is important and can literally set the stage for the success or failure of the entire fluid handling system.

▶ Entegris has been supplying fluoropolymer fittings into the high purity chemical markets for over 30 years and our Flaretek® fitting product line remains an industry leading connection system.

▶ Today, we have incorporated our unique designs in our next generation of PFA fittings while retaining the very best of time proven features. We couldn't be more pleased with the results and we are proud to introduce PrimeLock, our new line of PFA fittings. It's safe, robust, clean and very user friendly.

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New 150 mm wafer transport, process and shipping products for thick 150 mm substrates for the Semiconductor Compound and LED markets

Entegris is pleased to support the trends in the Compound Semiconductor and LED market regarding thicker 150 mm substrates with a new set of wafer transport, process and shipping products engineered for thicker and thinner 150 mm substrates.

150 mm transport carrier for thick and thin wafer handling

- STAT-PRO® 3000 material
- Temperature resistant to withstand up to 120°C
- Abrasion resistant and dimensionally stable
- Open side wall style and automation flanges
- 12 capacity
- Pocket flat: 2.64 mm
- Part number: 125-175-47C02



150 mm STAT-PRO 3000 transport carrier

150 mm process carrier for thick and thin wafer processing

- PFA material
- Temperature resistant continuous use up to 180°C
- Dimensionally stable
- Open side wall style and automation flanges
- 12 capacity
- Pocket flat: 3.81 mm
- Part number: 125-160-0215



150 mm PFA process carrier

150 mm Ultrapak® shipper for thick wafer shipping

- Designed for safe shipping of up to 1.3 mm thick wafers 150 mm UP Shipper
- High-purity polypropylene material
- Maximum recommended temperature 50° C
- Individual cantilever springs to limit and reduce wafer rotation, breakage and particle contamination
- Ultra pure polypropylene assures low level of organic and inorganic contamination
- Three piece assembly, base, cover and cassette
- 25 capacity
- Part number:
 - Cleaned H9150-0043PA
 - Uncleaned H9150-0042PA



150 mm UP shipper

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