Dry Film Resist Stripping

Thick photoresist is needed for several processes, such as via etching and bump or pillar plating, during the fabrication of Wafer Level Packaging and Thru-Silicon Vias. Dry Film Photoresist and Lamination is being used for these applications. These dry film materials typically have a densely crosslinked 3D network in order to obtain the required physical properties for withstanding the electroplating process. Removal of these dry film materials can be challenging. New chemistries are being developed to assist in the removal of these Dry Film Photoresists. The use of a combination batch soak followed with single wafer spray provides a robust process for stripping dry film photoresist.

Two Technologies in One has combined two process techniques in a single system, to provide superior results. Immersion processing is used with heated solvents for longer cycle time processing, while a single wafer spray process is provided as a final processing step.

Batch soak complements single wafer spray for stripping dry film resist.

Immersion Processing

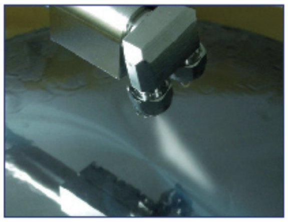
Each wafer is soaked under precisely controlled conditions in a heated, recirculating, solvent immersion bath. Typical soaking times are on the order of 10 to 20 minutes, with the robotics automatically shuttling wafers in and out. Sequencing is based upon the downstream process times and number of single wafer spray stations, assuring each wafer is soaked the same amount of time.

Single Wafer Solvent Spray Processing

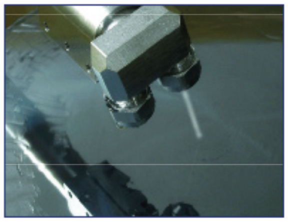
Following the soak, the solvent wet wafer is transported to a single wafer spin process station for complete removal of the dry film photoresist and final cleaning of the wafer surface. Having been softened by the soak, the resist is rapidly removed with a high pressure process that includes needle and fan spray, both with heated solvent solutions at pressures up to 3,000 PSI.

The high pressure spray is fully controlled through a flow rate monitoring system, with per-wafer data collection. The flow data can be passed through an SECS GEM link. By monitoring the flow rate, the software can detect a clogged nozzle, clogged filters, leaks in plumbing or pumps, or other faults.

The high pressure spray process is enhanced by the action of point-of-use, high pressure solvent heaters. These ETL listed heaters will heat the solvent up to the chemistry flash point.



High pressure spray, with point-of-use-heated solvents.



High pressure needle sprays, with pressure to 3,000 psi.

Forces on Wafer Due to High Pressure Fan Spray

Pump pressure PSI	1800	2300
Flow rate cc/min	372 (300)	456
Total force on wafer gram	27 (37)	40
Pressure on wafer @ 1" PSI	0.24	0.35
Pressure on wafer @ 2" PSI	0.06	0.09
Velocity at exit of nozzle in/sec	5030	6160

Forces on Wafer Due to High Pressure Fan Spray

Pump pressure PSI	1500	2000	2500
Flow rate cc/min	370	427	475
Total force on wafer gram	7	9.5	12

Nozzle Height Does Not Affect Force

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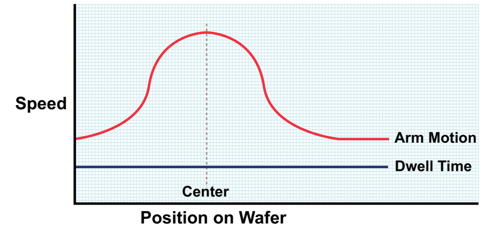
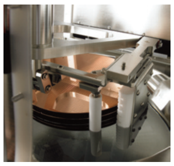
Precision Surface Processing

Uniformity of strip is optimized by maintaining constant dispense dwell times across the wafer surface. This is accomplished by the use of non-linear motion profiles. A hyperbolic profile ensures equal dwell time across the wafer, whether dispensing is at the center or edge of the wafer. Speed, acceleration, deceleration, time, and nozzle height are all programmed by recipe for highest precision.

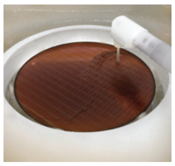
Hyperbolic Dispense Arm Motion



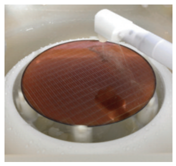
Veeco has developed a process for stripping these materials using our combination of batch immersion followed by single wafer spray processing. The steps are outlined below:



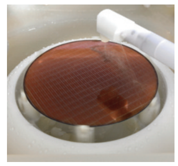
Step 1: Heated Immersion Process



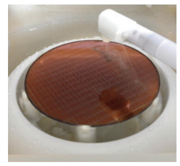
Step 2: Heated Recollected Solvent#1 Stream



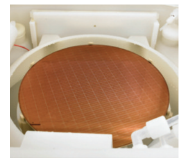
Step 3: Heated HPC Fan Spray, Fresh Solvent#1



Step 4: IPA Rinse

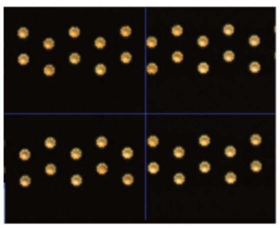


Step 5: DI Water Rinse

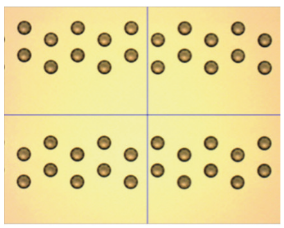


Step 6: Dry

Optical microscope images before and after stripping:

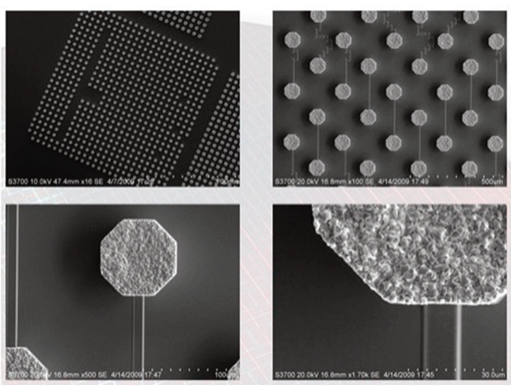


Pre-strip



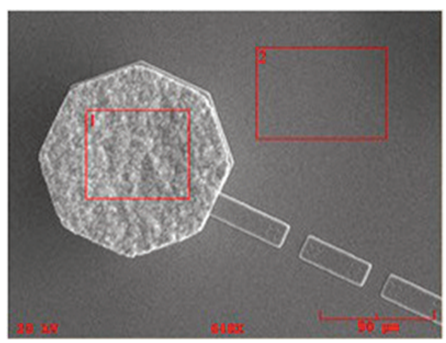
Post-strip

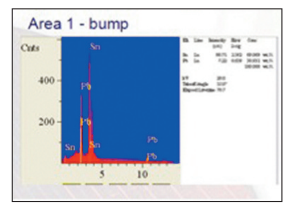
To ensure that we have completely removed all of the dry film resist material and not left any residue we are doing SEM and EDX analysis. Below are SEM images of the resulting structure after strip. The clean surface is observed, especially at the higher magnifications.



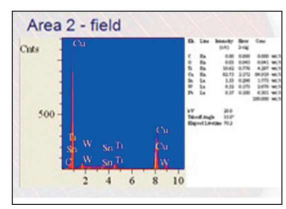
To look more closely at the surface to identify the surface compositions, we then do an EDX on the metal bump and background field. **Energy dispersive X-ray spectroscopy** (EDS, EDX or EDXRF) is an analytical technique used for the elemental analysis or chemical haracterization of a sample. As a type of spectroscopy, it relies on the investigation of a sample through interactions between electromagnetic radiation and matter, analyzing x-rays emitted by the matter in response to being hit with charged particles. Its characterization capabilities are due in large part to the fundamental principle that each element has a unique atomic structure allowing x-rays that are characteristic of an element's atomic structure to be identified uniquely from each other.

The locations in the boxes are analyzed.





The analysis of the bump area identifies the metals (Pb, Sn).



Next the analysis of the background field area shows no residual carbon indicating no residual resist.

Veeco Systems for Effective, Safe Dry Film Stripping Performance

All Veeco systems meet SEMI® S2-0706E safety and SEMI S8-0705 ergonomic compliant, CE Marked, and ETL Listed.

Veeco 3303/4 Fully Automated, 3-4 Process Modules

Veeco 3305/6 5-6 Processing Modules

Veeco 3308/12 8-12 Processing Modules

Learn more about Veeco's single wafer process capabilities at www.veeco.com/PSP

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