

Cleaning in Advanced Packaging

MKS' broad technology platform provides highly efficient solutions ensuring excellent cleaning and surface preparation of thin films.

Introduction

As electronic consumer devices continue to become smaller and lighter with increased performance, advanced packaging pushes the limits of innovation in the semiconductor industry. Advanced packaging has evolved to keep pace with industry needs to reduce package size, decrease power consumption and increase chip connectivity while improving reliability, performance and multi-function integration. As advanced packaging processes and 3D integration drive back-end adaptations of front-end processes, MKS Instruments' extensive experience as a front-end manufacturing supplier helps us understand, anticipate and support the changing needs of the back-end packaging environment. MKS, a long standing solutions supplier for front-end semiconductor fabrication, has partnered with our customers solving their most challenging advanced packaging problems, leveraging our technical innovation, experience and passion.

Chip packaging technology that meets industry expectations of size, power, yield, and cost continues to evolve with new advanced packaging chip methods including 3D and 2.5D glass and silicon interposers. These new and unique processes to interconnect and integrate chips into final assemblies present new challenges in deposition, etch, singulation and clean for both front-end foundries and back-end packaging suppliers.

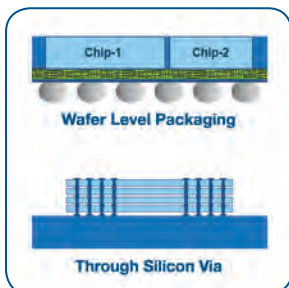
MKS products solve key Advanced Packaging Cleaning challenges and are

more environmentally friendly than wet clean and other chemicals with high performance solutions in:

- Microwave Plasma
- RF Power
- Ozone

New Challenges in Cleaning Processes

The increase in etch and deposition steps, new materials, and new structures used in 2.5D and 3D packaging rely heavily on cleaning processes like photoresist strip and descum to ensure contamination free surfaces. Devices require varying levels of cleanliness using different materials throughout the manufacturing process so it is increasingly important to offer multiple cleaning options to achieve the required clean levels to ensure good devices and high yield. Surface activation, an important process tied to cleaning,



conditions and prepares the surface for the next process step ensuring good quality adhesion resulting in high quality die.

Challenges specific to Cleaning include:

- Contamination free surfaces for highly sensitive devices
- Surface preparation and activation for better adhesion
- High throughput, ensuring minimal cycle time for higher overall productivity
- Ecologically friendly alternatives to concentrated sulfuric acid wet clean or others

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MKS Solutions

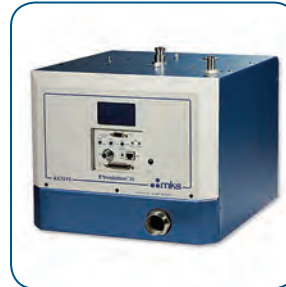
Cleaning has become increasingly complex as etching and implant technologies have evolved. Extensive etching needed for 2.5D and 3D structures results in a high amount of polymers or other by-products that must be removed to ensure a clean surface for the next process.



MKS' RF and Microwave Plasma products are excellent dry alternatives to wet photoresist removal. Photoresist strip is a combination of cleaning and surface preparation that conditions the surface in preparation of the next process step. Compatible with multiple process gases

ensuring the best clean based on material chemistries, MKS' RF and Microwave Plasma products provide an economical and green alternative to wet cleans which use acids and solvents that require special storage and disposal. Plasma clean processing lowers the cost of operation by eliminating the need to purchase, handle and store costly acids and solvents. MKS provides both RF and Microwave Plasma Generator technology to support varying requirements. MKS' Microwave Plasma operates at lower process temperatures maintaining the integrity of the bonding material between the wafer and carrier during processing. When operating at higher temperatures is not a concern, MKS RF Generators provide an excellent cost sensitive solution. MKS RF and Microwave Generators are offered at multiple power levels and provide easy process chamber integration.

Via creation by the Bosch process or Deep Reactive Ion Etch (DRIE) technology leads to etch process by-products recombining and accumulating on via sidewalls. This contamination, if not cleaned, leads to poor metal adherence in the next process step resulting in poor electrical interconnect and ultimately a bad die. Plasma, due to its' gaseous nature, is able to penetrate the vias easily to successfully remove all contaminants. This attribute also makes plasma an optimal choice for cleaning under flip chip and interposers which have limited access.



radical creation with either a Microwave Plasma System or R*evolution® Toroidal Plasma Source.

Similar to the front-end process, chamber clean integrated into deposition and etch equipment using MKS' Remote Plasma products is an important step ensuring no particulate contamination of the next wafer. MKS' ASTRON® Remote Plasma Source provides neutral radicals, chemically cleaning the chamber without damaging the surface. Used in situ, it increases productivity by reducing the down time of manual cleaning.



As an alternative to wet cleans or dry plasma etching, MKS has dissolved and gaseous Ozone Systems and Generators. Ozone is an environmentally friendly alternative for current semiconductor device cleaning chemistries. With reduced cleaning steps, lower temperature, better cost of ownership and improved performance with lower chemical consumption, MKS Ozone Generators and Delivery Systems are a replacement for RCA clean and organic solvents. MKS' LIQUOZON® Delivery Systems feature the highest concentrations in the market with the lowest cost of ownership, especially when using recirculation for unused dissolved ozone.

MKS' RF Power and Plasma, Microwave Plasma and Ozone solutions provide better yield and higher throughput by solving problems in surface preparation and activation for better adhesion, and providing contamination free substrates for highly sensitive devices used in 2.5D and 3D advanced packages.