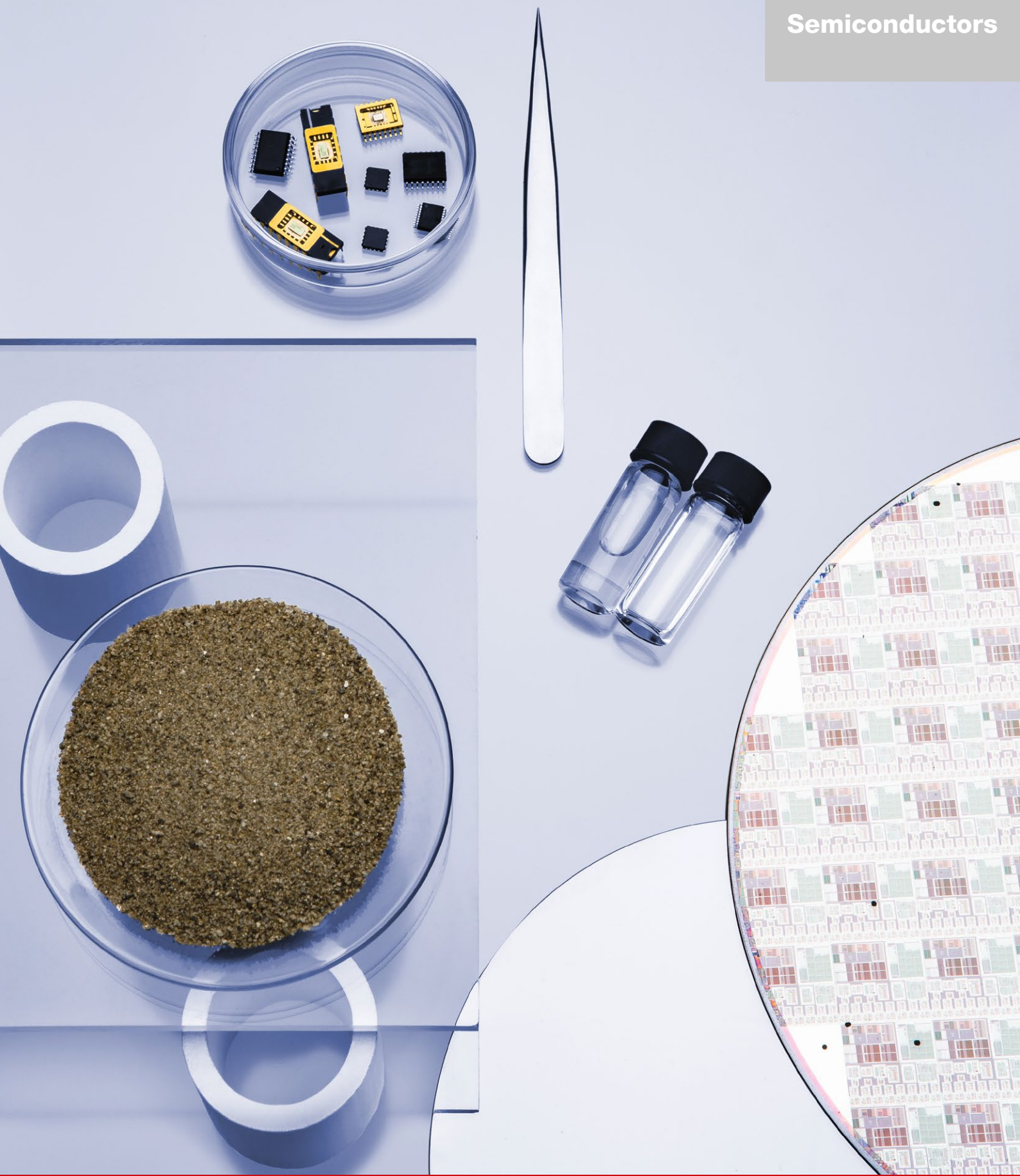
Solutions for Optimizing Wafer Production

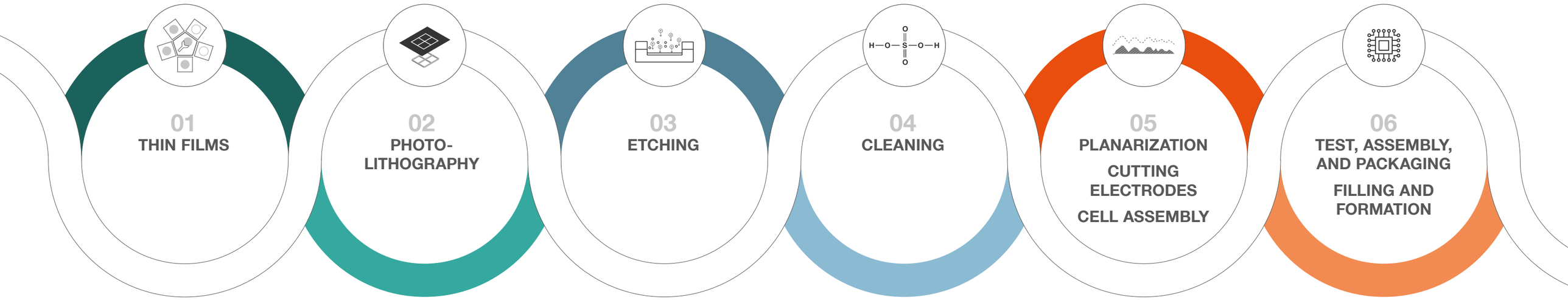
Anton Paar

Semiconductors



Wafer Production **at Its Best**

From thin films to testing, assembly, and packaging, our measurement solutions support you at every manufacturing step.



AS AN INTEGRATED CIRCUIT (IC) DESIGNER AND MANUFACTURER, YOU WANT TO ENSURE THAT THE MATERIALS AND LAYERS USED IN IC PRODUCTION HAVE THE CORRECT MECHANICAL PROPERTIES.

Solution: Characterize the hardness and elastic modulus and adhesion of thin layers on wafers with **mechanical surface characterization** (using nano scratch testing and low-load indentation testing) to have full control of the deposited functional layers during the integrated circuit development.

YOU WANT TO AVOID CONTAMINATION OF PHOTOMASKS, WHICH AFFECTS THE QUALITY OF INTEGRATED CIRCUITS.

Solution: Determine the correlation between different cleaning agents and the photomask by measuring the **zeta potential** (surface charge analysis). In this way, you can optimize the performance of cleaning procedures for photomasks.

YOU WANT TO DETERMINE THE CONCENTRATION OF THE HYDROFLUORIC ACID TO GET A CONSISTENT ETCHING PERFORMANCE.

Solution: Quickly check the acid concentration by **concentration measurement** with a chemically resistant Hastelloy U-tube density meter, to determine the hydrofluoric acid concentration for reproducible etching processes.

YOU WANT TO QUICKLY DETERMINE THE CONCENTRATION OF SULFURIC ACID APPROX. 10 TIMES FASTER THAN WITH THE TRADITIONAL TITRATION METHOD.

Solution: Measure density and sound velocity with one instrument (**concentration measurement**), as due to the non-linear concentration curve of sulfuric acid both technologies are required. This allows you to guarantee high repeatability and reproducibility of the cleaning process.

YOU WANT TO AVOID CONTAMINATION OF SILICON WAFERS WITH DIFFERENT TOP COATINGS DUE TO CONTACT WITH COMPONENTS OF THE SLURRY DURING CHEMICAL-MECHANICAL POLISHING.

Solution: Determine the zeta potential of wafer surfaces and slurry particles with **surface charge analysis,** to optimize process conditions and avoid particle adhesion through electrostatic interactions. This increases throughput thanks to reduced cycle times in post-CMP cleaning.

AS A SEMICONDUCTOR PACKAGING SERVICE PROVIDER, YOU HAVE TO MAKE SURE THAT THE PACKAGING PROCESS IS DONE CORRECTLY AND THE USED MATERIALS (BOND PADS, CONNECTIONS, BALL GRID ARRAYS, ETC.) HAVE THE CORRECT MECHANICAL PROPERTIES.

Solution: Determine **mechanical surface characteristics** such as hardness and elastic modulus in local measurements with a nanoindentation tester. This way the highest packaging material quality is ensured. You can be sure that the integrated circuit (IC) is well-protected and will function perfectly throughout the lifetime of the final product.

Measuring Instruments for Optimizing Wafer Production

SURFACE CHARGE AND PARTICLE SIZE ANALYIS

By analyzing the zeta potential and solid surface charge, SurPASS 3 gives insight into the electrostatic interaction between wafers and their actual environment. Independent of their size, wafer samples can be loaded in the proprietary SurPASS 3 Clamping Cell and characterized destruction-free. A determination of the surface's isoelectric point reveals the surface chemistry of the outermost material layer. Time-resolved adsorption studies visualize any changes in the surface properties caused by liquid-on-solid surface adsorption and desorption processes in real-time.

The zeta potential of slurry particles can be determined with Litesizer 500, which helps to analyze electrostatic interactions between the slurry and the wafer surface. SurPASS 3 and Litesizer 500 can be used to optimize process conditions and to reduce post-CMP cleaning cycles. Furthermore, characterizing the particle size of slurry particles with Litesizer 500 leads to improved polishing performance and reduction of damage to the wafer surface.

Parameters: Zeta potential | Surface charge | Isoelectric point | Liquid-on-solid surface adsorption kinetics | Particle size | Refractive index

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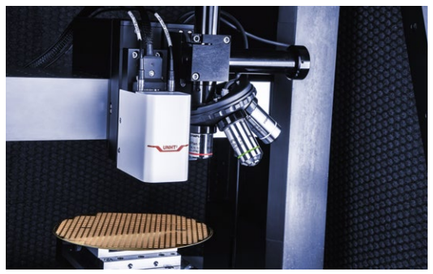
MECHANICAL SURFACE CHARACTERIZATION

For the mechanical surface characterization of wafers, Anton Paar offers two state-of-the-art measuring technologies, namely scratch testing and instrumented indentation testing. Achieving excellent adhesion and high scratch resistance of functional thin films is very important for wafer and integrated circuit production. The most suitable and easiest method for measuring adhesion is the nano scratch test with an NST³ that uses a diamond tip. UNHT³ is the perfect tool for characterizing most thin films on wafers, e.g. for evaluating the quality of the thin film deposition process by measuring the hardness and elastic modulus during wafer production.

Parameters: Thin film adhesion | Scratch resistance | Hardness | Elastic modulus



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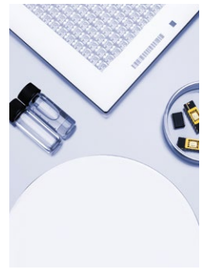
DENSITY AND CONCENTRATION MEASUREMENT

DENSITY AND SOUND VELOCITY METERS

The correct concentration of the etching substance is key to getting consistent etching results. Digital density measurement is the ideal method for the highly accurate determination of the concentration of acids and bases in the etching and cleaning process. DMA 4200 M measures the hydrofluoric acid which is used in the etching of oxide layers. The combined density and sound velocity meter DSA 5000 M is used for measuring the concentration of ternary solutions, such as the sulfuric acid required for cleaning and polishing wafers.



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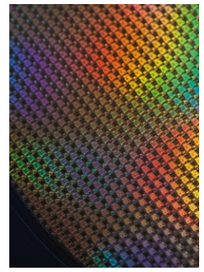
REFRACTOMETERS

To ensure proper cleaning without residues on the wafer surface, the purity of the cleaning agent can be checked using a highly precise refractometer from the Abbemat Performance and Performance Plus line. The goal is to save time and resources by accelerating and improving the cleaning process.



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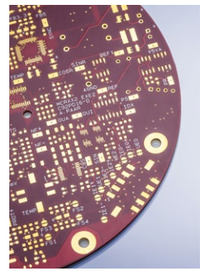
PROCESS SENSORS

For continuous quality monitoring of your cleaning process, concentration measurement of acids and bases can also be carried out in the process environment with Anton Paar's high-performance process sensors L-Dens 7400 and L-Com 5500. These sensors cover the entire concentration range of H_2SO_4 (0 % to 100 %). L-Dens 7400 can also be used for slurry density measurement to inline-monitor your slurry properties in the CMP process. Real-time data indicates slurry health and detects changes in abrasive concentration.



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Parameters in the lab: Density | Specific gravity | Concentration | | Refractive index | Viscosity
Parameters in the process environment: Density | Concentration

Measuring Instruments for Optimizing Wafer Production

MICROWAVE DIGESTION

Microwave digestion is the method of choice to prepare materials for subsequent elemental analysis in order to determine inorganic impurities. This is important to ensure the quality of base materials and the correct functionality of final products. With Anton Paar's microwaves, each material is prepared in a fast and reproducible way.

SOLID DENSITY ANALYSIS

Knowing the open and closed porosity of polishing pads used in the process step of planarization is important when selecting the optimal pad and for the continuity of process parameters. Porosity can be quantified by Ultrapyc 5000 Foam, a gas pycnometer which allows you to monitor quality and ensure a consistent microstructure of polishing pads from lot to lot.

Parameters: True density

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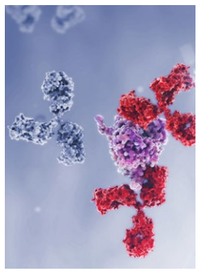
SAXS

Grazing-incidence small-angle x-ray scattering (GISAXS) can be used to investigate the structural features of thin films. This X-ray method not only allows investigation of the surface structure, but also makes it possible to deliver information on features below the surface, resulting in information about the coating quality and nanostructure distribution of thin films. Anton Paar's SAXSpoint 5.0, a laboratory beamline with synchrotron detector technology, is able to apply this method and also SAXS, WAXS, and RheoSAXS studies.

Parameters: Correlation length | Space group | Particle shape | Particle size | Relative roughness



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Anton Paar
Certified Service

"We're confident in the high quality of our instruments. That's why we provide **a full warranty for three years**."

All new instruments* include repair for three years.
You avoid unforeseen costs and can always rely on your instrument.
Alongside the warranty, we offer a wide range of additional services and maintenance options.

*Due to the technology they use, some instruments require maintenance according to a maintenance schedule. Complying with the maintenance schedule is a prerequisite for the three-year warranty.

SERVICE AND SUPPORT DIRECTLY FROM THE MANUFACTURER

Our comprehensive service provides you with the best individual coverage for your investment so that maximum uptime is ensured.

SAFEGUARDING YOUR INVESTMENT

Regardless of how intensively you use your instrument, we help you keep your device in good shape and safeguard your investment – including a three-year warranty.

THE SHORTEST RESPONSE TIMES

We know that sometimes it's urgent. That's why we provide a response to your inquiry within 24 hours. We give you straightforward help from real people, not from bots.

CERTIFIED SERVICE ENGINEERS

The seamless and thorough training of our technical experts is the foundation of our excellent service provision. Training and certification are carried out at our own facilities.

OUR SERVICE IS GLOBAL

Our large service network for customers spans 86 locations with a total of 350 certified service engineers. Wherever you're located, there's always an Anton Paar service engineer nearby.

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