Thermo Scientific Theta 300 and Theta 300XT

Complete Wafer Surface and Thin Film Characterization


Surface Composition


Interface Characterization


Ultra-thin Films


Gate Dielectrics

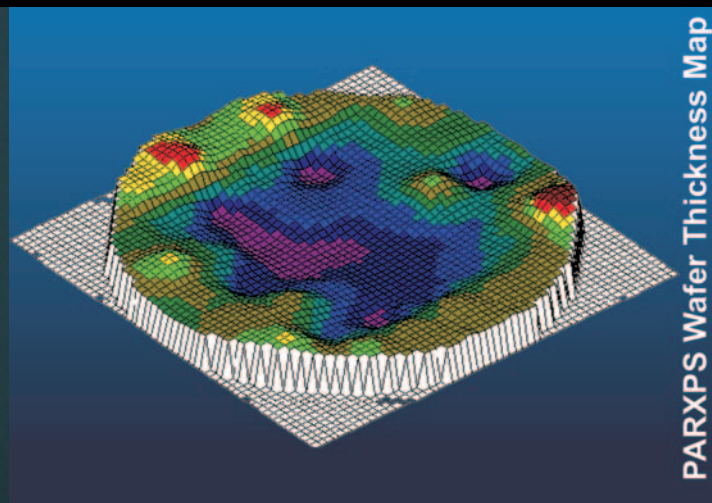
The Thermo Scientific Theta 300 is a major advance in the characterization of ultra-thin films.

Using revolutionary technology Theta 300 non-destructively measures:

- Dose
- Purity
- Distribution
- Thickness
- Uniformity
- Chemical composition

Applications Include:

- High-k
- Low-k
- Barrier seed
- Shallow implant
- Metal gate
- Self-assembled monolayers
- SiGe
- Test pad analysis
- Bond pad analysis



PARXPS Wafer Thickness Map

Advanced, Unique, Versatile

Aggressive scaling of device parameters creates new challenges for process engineers through the introduction of new materials, increasingly thinner films and shallower junctions.

New processes require new methods of characterization and metrologies. With stacks approaching atomic dimensions the limitations of existing techniques, such as ellipsometry, are exposed. More complicated materials require the control of chemical distribution and stoichiometry.

Theta 300 has been developed in conjunction with world class semiconductor laboratories to provide precise measurement of film thickness and composition.

Theta 300 non-destructively determines the thickness and composition of films up to 10 nm and provides accurate chemical distribution profiles through stacks. Uniquely, these profiles are non-destructive and so preserve the chemical state information that determines the film's electrical characteristics.

A carrier handling version of the tool, Thermo Scientific Theta 300XT, is available having the same analytical capabilities as Theta 300. Theta 300XT is configured with two loadports for 200 or 300 mm carriers. With this option, fully automated, unattended operation becomes routine.

Theta 300 is the tool for characterization and process control.

Theta 300

Theta 300 combines X-ray Photoelectron Spectroscopy (XPS) with Parallel Angle-resolved XPS (PARXPS) to provide an extremely powerful analytical tool.

XPS

XPS provides a quantitative determination of the elemental and chemical state composition of the surface of a solid material.

Full wafer maps are used to examine the uniformity.

Theta 300 is also equipped with a source of energetic ions that can be used in combination with XPS measurements to provide concentration depth profiles. This is essential for thicker layers.

PARXPS

Based on the highly successful Thermo Scientific Theta Probe tool, Theta 300 uses Parallel Angle-resolved X-ray Photoelectron Spectroscopy (PARXPS) for non-destructive determination of:

- Chemical composition
- Thickness of ultra-thin films beyond the limit of ellipsometry
- Depth profiles
- The sequence of layers in a stack
- Thickness measurement of buried layers
- Uniformity of thickness, composition and distribution of material within a layer or across a wafer

Only we can provide this capability.

Sample Handling

Theta 300 features a versatile and fully automated sample handling system:

- 300 mm wafers
- 200 mm wafers
- Small samples
- Thick samples
- Mask handling
- Azimuthal rotation

The advanced optical system, integral to Theta 300, facilitates feature alignment. This can be used in combination with pattern recognition software to increase throughput and to provide automated feature analysis.

Avantage

Theta 300's Avantage data system extracts the maximum amount of information from each measurement and features a comprehensive set of processing tools for characterizing new materials:

- Relative depth plots
- Multiple layer thickness calculator
- Depth profile generator
- Mapping and uniformity statistics

Measurement

Theta 300 provides quantitative measurement of elemental and chemical states.

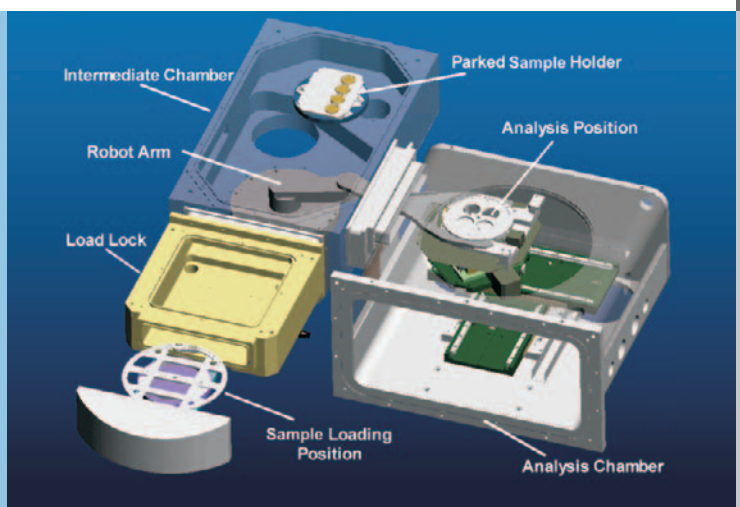
Measurement of all types of structures:

- Metallic
- Dielectric
- Semiconductor
- Transparent
- Opaque
- Polymeric

Operation

Theta 300's automated operation allows:

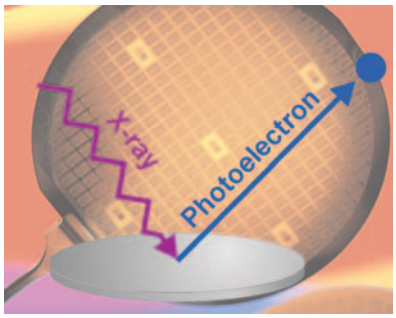
- One click sample loading
- Recipe based user interface
- Automatic mapping of thickness and dose
- Automatic report generation
- Unattended carrier exchange



Theta 300

X-ray Photoelectron Spectroscopy

Highly monochromatic soft X-rays are used to excite core electrons in the sample, causing photoelectrons to be ejected. The photoelectron kinetic energy is measured and the binding energy calculated using the known X-ray energy. The elements present and their chemical states is determined from a spectrum of these binding energies.

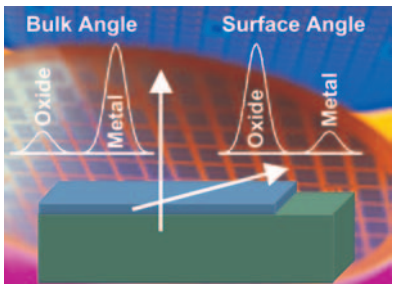


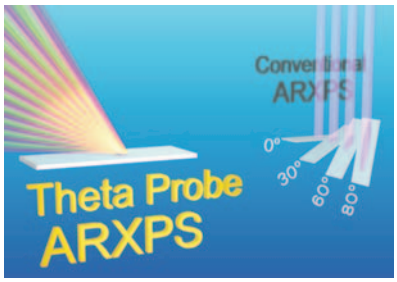
Angle-resolved XPS

The information depth in photoelectron spectroscopy is determined by the angle at which the electrons are collected. Conventional Angle-resolved XPS (ARXPS) is time consuming and inaccurate as it requires the sample to be tilted and a measurement taken at each angle.

Parallel ARXPS

Our patented Theta technology allows data from each angle to be collected in parallel in a single measurement. This capability allows Theta 300 to provide non-destructive depth profiles throughout an ultra-thin film stack.





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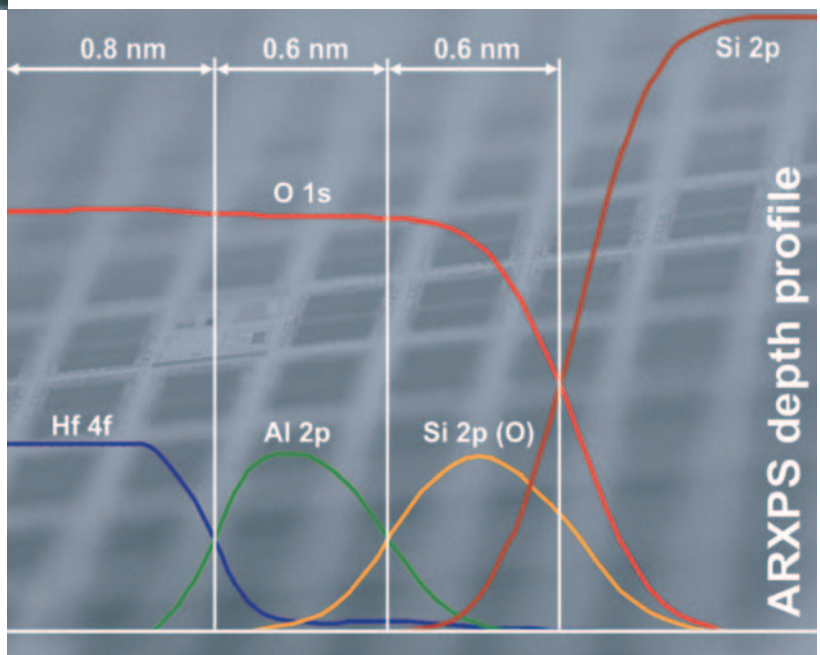

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