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FRAUNHOFER CENTER
FOR SILICON PHOTOVOLTAICS CSP

WAFER SURFACES: QUANTITATIVE ANALYSIS OF METALS AND ORGANIC IMPURITIES

FRAUNHOFER CSP

The Fraunhofer Center for Silicon Photovoltaics CSP conducts applied research in the area of crystallization, solar modules and solar wafers. With top competencies, Fraunhofer CSP explores the field of ingot manufacturing and material development. Moreover, the manufacture and assessment of solar cells and modules as well as electrical, optical, and micro-structural materials and component characteristics are also carried out. Ultra-modern research and analytical equipment is available for these activities.

CONTACT US

Dr. Sylke Meyer
Group Manager Silicon Wafers
Fraunhofer Center for Silicon Photovoltaics CSP
Otto-Eißfeldt-Straße 12 | 06120 Halle (Saale)

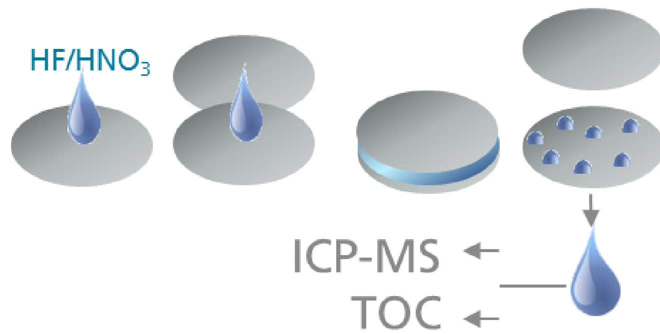
Phone: +49 345 5589-5116 | Fax: +49 345 5589-5999
sylke.meyer@csp.fraunhofer.de | www.csp.fraunhofer.de

MAJOR APPLICATIONS

Diagnostics of Solar Cells:

- Metallography, ion and laser beam assisted sample preparation tools
- Laser structuring, inkjet printing
- Microscopy (optical, NIR)
- Analytical scanning electron microscopy with EDX, EBSD, EBIC
- Transmission electron microscopy
- Focused ion beam
- Time of flight secondary ion mass spectrometry
- X-ray photo electron spectroscopy
- Scanning probe microscopy
- Electrical micro probe characterization
- Scanning acoustic microscopy
- Trace element analytics (HR-ICPMS)
- Electrical characterization

Surface extraction:



QUANTITATIVE DETERMINATION OF SURFACE IMPURITIES

Due to the manufacturing process (wire sawing, wet chemical cleaning), handling and packaging wafer surfaces are prone to manifold contaminations. Metal ions – on the one hand - often act as highly active recombination centers and thus significantly decrease the solar cell efficiency. Organic impurities – on the other hand – influence subsequent processing steps like texturing and thus, impair the solar cell quality as well. This is even more relevant for the manufacturing of recent high efficiency cells.

To monitor the chemical surface quality of solar wafers several analytical techniques were developed at Fraunhofer CSP. Surface concentrations of individual metals as low as 1*108 atoms/cm^2 can be determined with surface extraction followed by ICP-MS. A similar method is available for organic impurities: The content of total organic carbon (TOC) can be determined quantitatively after acid surface extraction. Additionally, the surface energy of the whole wafer surface can be tested by measuring the contact angle of different liquids with local resolution. To identify the chemical nature of contaminating substances ToF-SIMS is used, which is a especially surface sensitive method with high local resolution.

ANALYTICAL TECHNIQUES FOR SURFACES

- Acid surface extraction
- High resolution ICP-MS
- TOC analysis
- Contact angle mapping
- ToF-SIMS
- Laser ablation ICP-MS

OUR SERVICES

- Analytical service of wafer samples
- Method development
- Validation of new cleaning processes
- Specification of wafer quality

MORE INFORMATION

- 12th UCPSS symposium, 2014, Brussels
- Meißner, D. et al., Energy Procedia 27 (2012) 27 – 32

SURFACE ENERGY MAP