

- 1 *High resolution ICPMS.*
- 2 *Wafer Cleaning Tool.*

## METALS AND ORGANIC IMPURITIES ON WAFER SURFACES

### Wafer Surface Quality

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 centres 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.

### Analytical Methods

In order to monitor the chemical surface quality of solar wafers there have been developed several analytical techniques at Fraunhofer CSP. Surface concentrations of individual metals as low as  $1 \cdot 10^8$  atoms per  $\text{cm}^2$  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 highly surface sensitive and locally resolved.

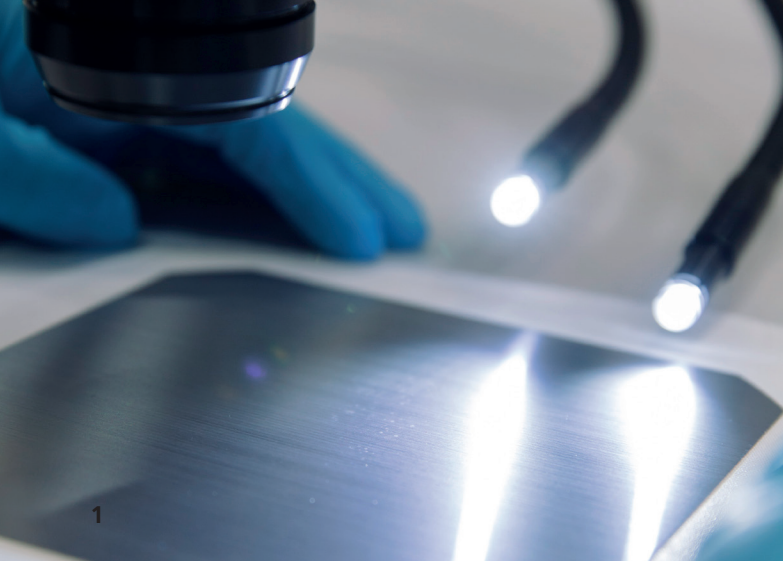
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### Analytical Techniques

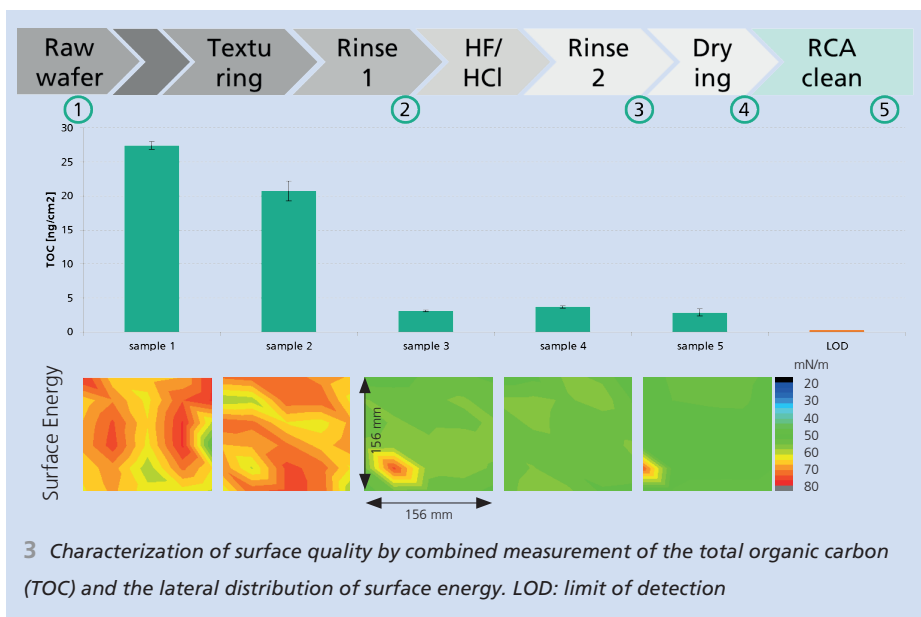
- Acid surface extraction
- High resolution ICP-MS
- TOC analysis
- Contact angle mapping
- ToF-SIMS
- Laser ablation ICP-MS

### Our Services

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

### Publications

- Meyer, S.; Wahl, S.; Timmel, S.; Köpge, R.; Jang, B.-Y.: The impact of wafering on organic and inorganic surface contaminations, Applied Surface Science 378 (2016) 384–387.
- Meyer, S.; Wahl, S.; Hagendorf, C.: Advanced metal contamination analysis for high efficiency solar cell manufacturing, 6th International Conference on Silicon Photovoltaics, SiliconPV 2016
- Lausch, D.; Hirsch, J.; Wahl, S.; Meyer, S.; Gaudig, M.; Bernhard, N.: Analysis of Surface Contamination Levels Induced by Maskless Plasma Texturing of Silicon Solar Wafers, Proceedings of the 31st EU PVSEC, (2015)
- Meyer, S.; Timmel, S.; Hagendorf, C.: Rapid determination of organic contaminations on wafer surfaces, Solid State Phenomena Vol. 219 (2015) 317-319
- Meißner, D.; Meyer, S.; Anspach, O.: Enrichment of metal ions in virgin Si-surfaces, Energy Procedia 27 (2012) 27 – 32.



1 Optical Wafer Inspection.

2 ICPMS results: as-cut wafer .