

Extract from the Annual Report 2023  
To the website: [www.ist.fraunhofer.de/en.html](https://www.ist.fraunhofer.de/en.html)

### #WeKnowSolutions

- Quantitative SIMS depth profile analysis of technical surfaces and layers
- Quantitative hydrogen determination in DLC layers or in silicon
- Non-destructive and spatially resolved determination of layer thickness and the composition of thin single- or multiple-layer systems (suitable for layer thicknesses from 0.3 to ~500nm), e.g. thin oxide-layer thicknesses
- Quantitative point analysis of light elements such as B, C, N, O in various materials
- Characterization of material fatigue by means of impact tests (up to 5kN, 1 million load cycles in 5 hours)

## Analytics and quality assurance

# Analysis of layers and surfaces

### What are the focal points of the department?

In the Analytics and Quality Assurance department, we perform complex material, layer and surface analyses for industrial and institutional customers. The focus thereby lies on the application of methods with large analytical devices such as scanning electron microscopy (SEM), electron probe microanalysis (EPMA), energy dispersive X-ray spectroscopy (EDX), secondary ion mass spectroscopy (SIMS), X-ray diffraction (XRD) and focused ion beam (FIB). Amongst other things, these devices are utilized for the failure analysis, the specification of new materials, quality assurance in production, the calibration of standards or the reverse engineering of unknown samples."

### What are the plans for the future?

The analysis of the diffusion of hydrogen into materials is to be further expanded. For this purpose, the institute has procured a reactor with which samples can be exposed to an H<sub>2</sub> or D<sub>2</sub> atmosphere at up to 300 °C and 200 bar pressure. SIMS depth profiling can subsequently be used in order to investigate the H or D distribution in the material over depth. A further focus lies on the possibilities offered through the analysis of lithium-based battery materials. A shuttle is available for this purpose, with which Li containing samples can be transferred into the FIB-SEM, a combination of scanning electron microscope (SEM) and focused ion beam (FIB), without contact with air, in order to be able to examine them without degradation."

### What were the highlights in the reporting year?

Within the framework of an exciting job for a large German company, we applied SIMS in order to investigate how deeply hydrogen diffuses into certain magnetic materials and to what extent protective layers can reduce this diffusion. For the Herzog August Bibliothek in Wolfenbüttel, we analyzed mineral particles that were discovered in writings on alchemy that are several hundred years old. During the investigations, we found lead oxides and lead nitrates. A further highlight was the investigation of superconducting coatings that are to be used for quantum computers, and we were also able to successfully conduct extensive characterizations of coatings for electrolysis and fuel-cell technology on behalf of a major German automotive supplier."

*The Focussed Ion Beam (FIB) device "Cross-Beam 340" from Zeiss is used for the preparation of local cross sections and TEM lamellae.*

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