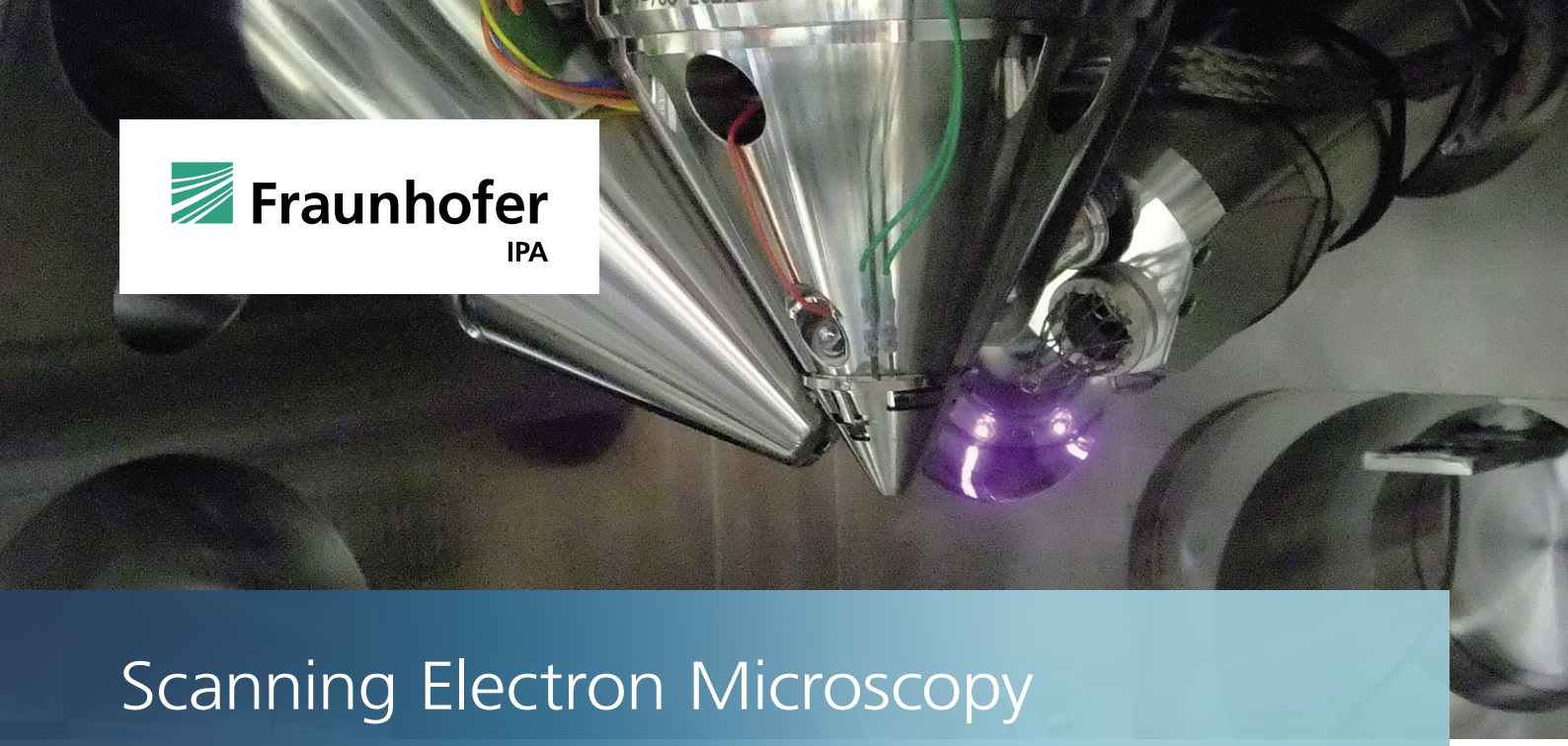


Fraunhofer IPA

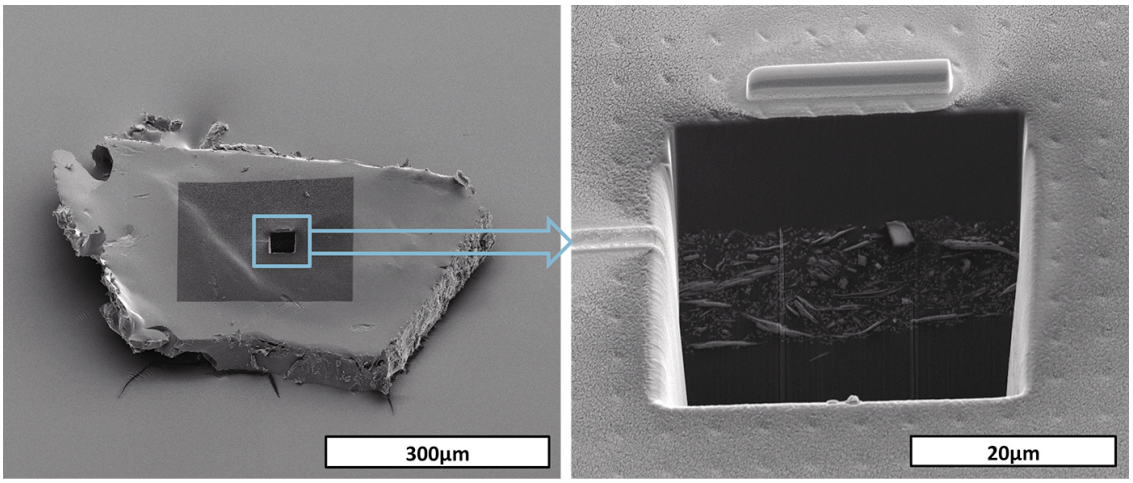
Scanning Electron Microscopy

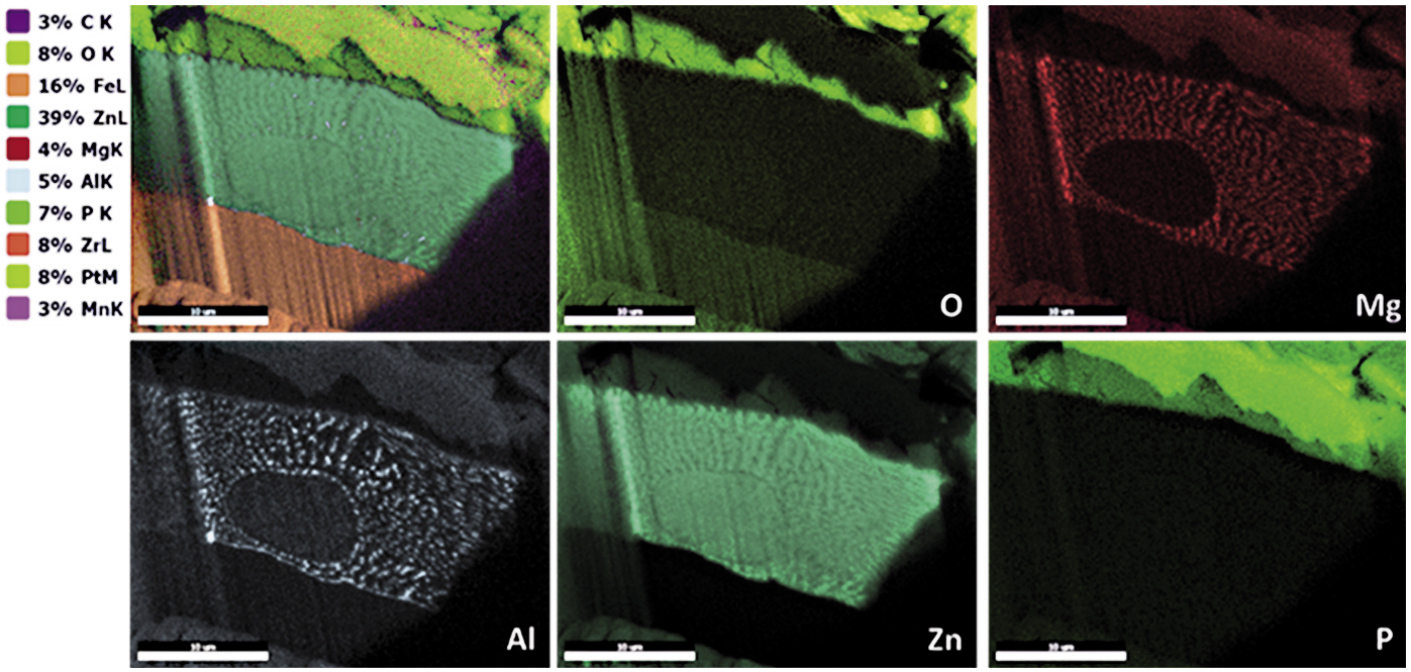
Modern surface, layer and damage analysis using REM, FIB, EDX, STEM

Electron microscopy extends the scope for studying layer structures and analyzing damage to coatings down to the nanometer scale. Microscopic analyses are performed using scanning electron microscopy (SEM) and transmission electron microscopy (TEM). Supplemented by spatially resolved X-ray spectral analysis (EDX), information about the chemical composition of samples in the micrometer range can be obtained. To characterize layers, a focused ion beam (FIB) can be used to prepare targeted and user-defined cross sections as well as STEM (Scanning Transmission Electron Microscope) lamellae for ultra-high resolution analysis.

The Department of Coating Systems and Painting Technology has a Helios NanoLab 600i dual-beam scanning electron microscope, which features an integrated focused ion beam (FIB) and energy dispersive X-ray (EDX) analysis.

Cross section of a coated sample.





Mapping elements contained in an FIB cross-section of a steel sheet pretreated by zinc phosphating and with a zinc-magnesium coating.

Main areas of use:

- Surface analysis
  - Surface structure
  - Elemental composition (EDX)
- Layer analysis
  - Layer structure (cross section, FIB)
  - Elemental composition of layers (EDX)
- Damage and defect analysis
  - Morphology of defects
  - Cross-sections of defects (FIB)
  - Elemental analysis (EDX)

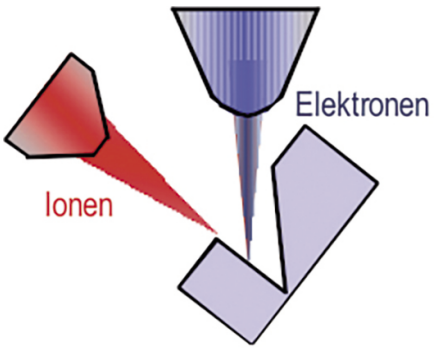
Outstanding imaging quality

Precise and detailed images – even at high magnifications (resolution down to 2 nm) – are obtained using a field emission electron beam. Thanks to low acceleration voltages and low beam currents, even delicate organic samples can be analyzed.

Focused Ion Beam (FIB)

The focused ion beam can be used to prepare user-defined cross sections of a sample in situ as well as TEM lamellae (e.g. for high resolution EDX). Images can also be generated with the built-in STEM detector by radiating through TEM lamellae. These methods are used to analyze damage patterns and assess particle sizes and distributions within coatings.

The "dual beam" principle.



Energy dispersive X-ray analysis (EDX)

The electrons from the electron beam excite the atoms located close to the surface of the sample (collision), which then emit X-rays with an energy specific to the element concerned. This allows the distribution of the respective elements to be detected and displayed with high local resolution (mapping).

Contact partners

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