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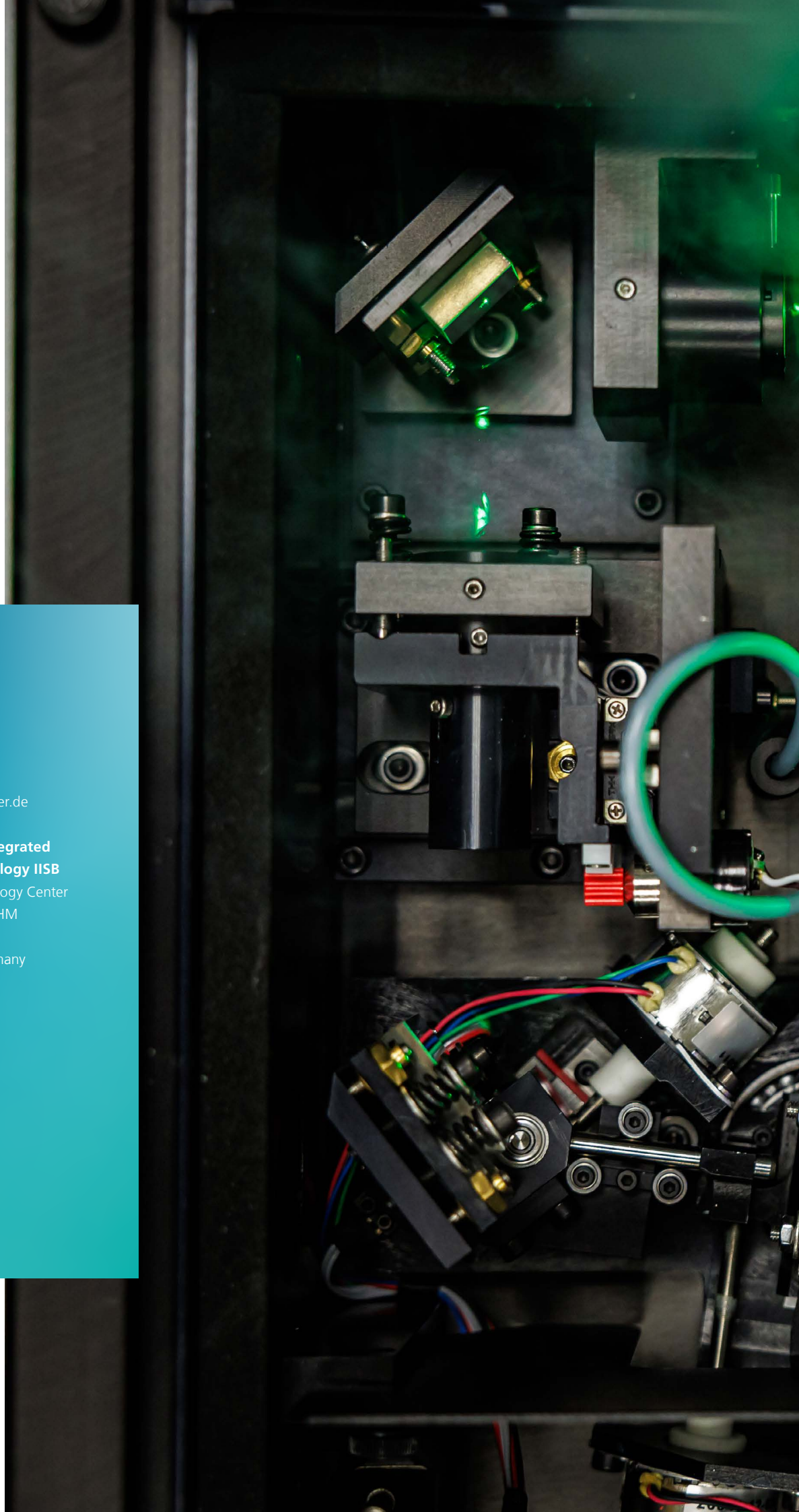
www.iisb.fraunhofer.de/operandoanalysis



Optics and filters mounted in the optical path of the Raman spectrometer
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Operando Analysis

Development of operando characterization techniques on electronic devices and in-line analysis of recycling processes

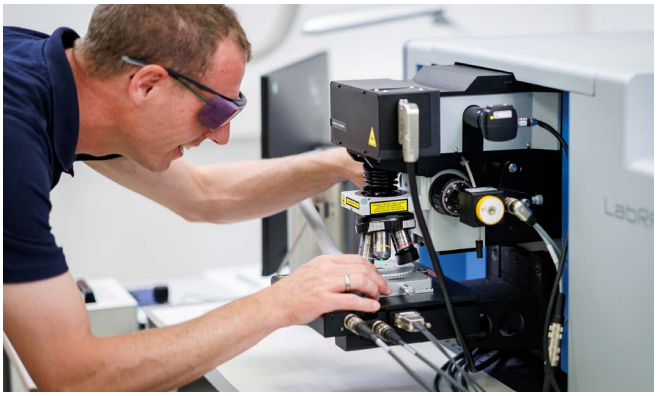
The demand for flexibility and functionality in semiconductor materials for power and communication electronics has increased. Compound semiconductors are crucial, offering superior properties compared to silicon. Defects in these materials may enable isolated quantum states for advanced quantum sensors or computers.

We have in-depth expertise in characterizing various crystal and wafer materials, allowing us to conduct timely service measurements for our clients. Our research focuses on operando characterization, assessing device performance and reliability. Early defect analysis helps to identify critical issues, enabling us to collaborate with clients on solutions for defect engineering.

Optical semiconductor characterization

Services

- Photoluminescence (PL) imaging for qualitative mapping of lateral inhomogeneities of charge carriers or their interaction with extended defects
- Confocal micro-Raman spectroscopy for monitoring residual mechanical stress and charge carrier density
- Measurement of lateral photovoltage (LPS) to determine phase boundaries, e.g. in Cz-Si
- Fourier transform infrared (FTIR) spectroscopy, e.g. to detect the concentration of oxygen, carbon and nitrogen dissolved in the silicon lattice
- Development of customized measurement methods together with industrial partners in the field of metrology



Material characterization at low temperatures © Daniel Karmann / Fraunhofer IISB

Key Topics

- Micro-Raman spectroscopy
- Photoluminescence spectroscopy

Assessing laser power at the objective lens © Daniel Karmann / Fraunhofer IISB

Structural semiconductor characterization

Services

- Phase and elemental analysis
- Determination of lattice parameters and residual stress
- Development of customized measuring methods together with measuring device manufacturers

Key Topics

- Structural analysis by high-resolution X-ray diffraction (HRXRD) and X-ray reflectometry (XRR)
- Qualitative and quantitative phase analysis using powder X-ray diffraction (PXRD) and Rietveld analysis
- Microscopy: light microscopy (VIS, NIR), confocal laser scanning microscopy (CLSM), scanning electron microscopy (SEM)

Investigation of microstructural defects using high-resolution X-ray diffraction © Daniel Karmann / Fraunhofer IISB

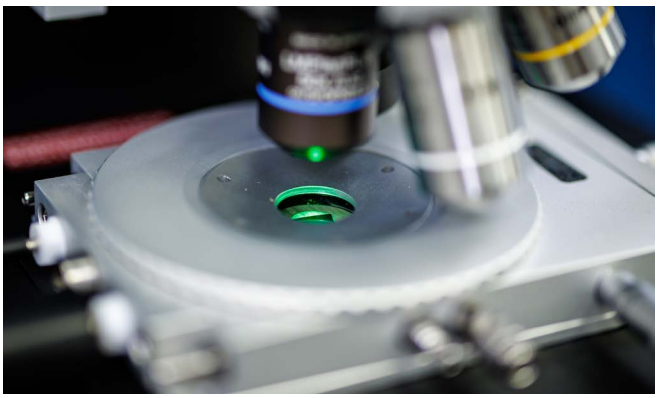
Operando and in-line analysis

Services

- Development and implementation of operando and in-line measurement techniques
- Thermochemical simulation for process understanding

Key Topics

- Operando investigations on electronic devices and modules
- In-line process monitoring of recycling processes using (spectroscopic) imaging techniques
- Application and (further) development of AI-based evaluation algorithms



Cooling and heating chamber (77 K - 600 K) for semiconductor samples © Daniel Karmann / Fraunhofer IISB