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Characterising materials is an integral part of developing reliable cells and PV modules – advancing PV research with each and every step. We offer a wide range of characterisation methods for our industry partners – especially for thin-film technology and perovskite solar cells. At ZSW you will benefit from our extensive knowledge along the value chain and experience with technology transfer for the industry since our founding days in 1988.

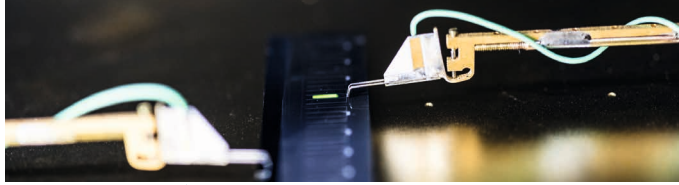
ZSW PHOTOVOLTAICS

MATERIALS RESEARCH

Thin-film characterisation services

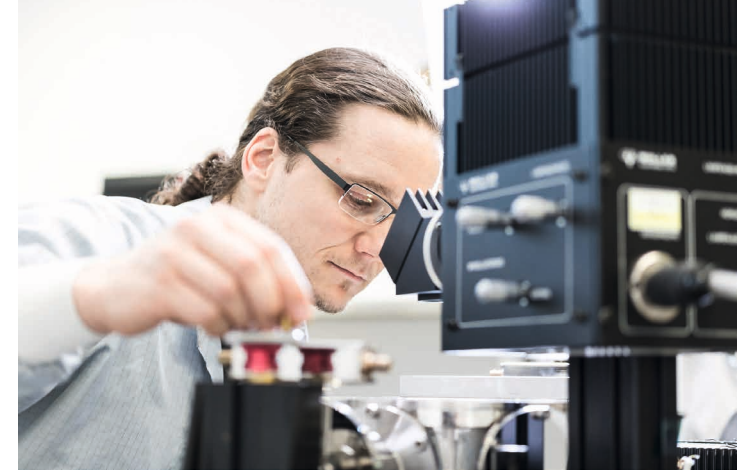
Photos: Alexander Fischer





Materials Characterisation	Tool	Purpose
EDX Energy-Dispersive X-ray Spectroscopy	Oxford Instruments Be(4) - U(92)	High-spatial-resolution composition by electron-beam-excited x-ray analysis
FIB-SEM Focussed Ion Beam-Scanning Electron Microscope	Zeiss Crossbeam 550 1 nm resolution, 10 nm film thickness	High-resolution imaging and milling
GDOES Glow Discharge Optical Emission Spectroscopy	Horiba GD Profiler 2 Element list available upon request	Depth profiles of composition by optical emission in plasma
Raman Spectroscopy	S&I (325, 442, 459, 488 nm) WiTec Microscope (532, 785 nm)	Phase identification by bond oscillations
ToF-SIMS Time-of-Flight Secondary Ion Mass Spectrometry	IonToF TOF.SIMS 5 Analysis Bi ⁺ , Sputter Cs ⁺ , O ₂ ⁺ , Ar cluster, O cluster; 200 nm lateral resolution, 6000 mass resolution, 1-2000 amu	Composition by mass spectrometry, depth profiles and 3D composition imaging
XPS X-ray Photoelectron Spectroscopy	SPECS Mg 1254 eV, Al 1487 eV and Cr 5417 eV	Surface elements and their chemical state
XRD X-ray Diffraction	Panalytical - Empyrean Cu-Kα, Bragg-Brentano or grazing incidence geometries	Phase identification by crystal structure
XRF X-ray Fluorescence	Fischerscope X-ray XVD-SDD Al(13) - U(92)	Composition and thickness of thin films

Optical/Optoelectrical Method	Tool	Purpose
OBIC, PL Mapping Optical Beam Induced Current, Photoluminescence	Home-built tool	Homogeneity of current generation, material quality
Optical microscope	Zeiss Axio	Identification of features, inspection of grid fingers and scribes
Optical spectroscopy UV-Vis-NIR with integrating sphere	PerkinElmer Lambda 900 Avantes AvaSpec	Optical characteristics: transmission, reflection, scattering
Profilometry	Keyence/Bruker DektakXT	Optical/tactile profilometry
Quantum Efficiency	Bentham	Spectral distribution of current generation and collection
Spectral Ellipsometry	Sentech/Woolam	Optical constants and film thickness for very thin flat films
TRPL Time-Resolved Photoluminescence	PicoQuant FluoTime 300 450 nm and 640 nm lasers	Calculation of charge carrier lifetimes from photoluminescence decay



Electrical Characterisation Method	Tool	Purpose
CV Capacitance-Voltage	Home-built tool	Calculation of charge carrier concentration
DLIT Dark Lock-In Thermography	Home-built tool with Thermo-sensorik IR camera	Imaging method to localize short circuits and current leakage
DLTS Deep-Level Transient Spectroscopy	PhysTech	Defect characterization
EL Electroluminescence	Andor i-Kon in darkbox	Imaging method for localisation of regions and faulty contacts
Hall effect	PhysTech RH 2010	Calculation of charge carrier concentration and mobility
Low-Temperature Characterization	ARS cryogenic probestation	Temperature dependency and low-temperature characterization of e. g. IV, CV
Transient Current-Voltage-Capacitance	Fluxim Paios	In-depth electrical characterization of perovskite solar cells
Solar Simulators, IV Current-Voltage characterization	Wacom (1- or 2-lamp, up to 10 × 10 cm ²) ABET (up to 30 × 30 cm ²)	Calculation of solar parameters for cells or modules in substrate or superstrate configurations, temperature adjustable
Sheet resistance Four Point Probe Mapping	Home-built tool up to 30 × 30 cm ²	Calculation of sheet resistance

