

# HR-SPS map

High resolution Surface Photovoltage Spectroscopy (SPS) tool with contactless electrical characterization and mapping of photoactive materials

for sophisticated material research & development

Si, SiC, GaN, GaAs, InP, Diamond, Ga<sub>2</sub>O<sub>3</sub>, CdTe, CdZnTe, AIN, Ge and more

# Features

#### Signal sensitivity

highest signal sensitivity for visualization of electro-optical processes in photoactive materials

Time resolution 10ns to 100ms

#### Material form factor

wafers, slabs, blanks, thin films, powder and nanoparticles

#### Measurement setup fixed wavelength

integration of up to four lasers in one measurement head for wide range injection level measurements or material specific customized measurements

#### Measurement setup wavelength scan

versatile measurement platform for advanced material research using broad wavelength light sources and double slit monochromators

#### Measurement speed

< 5 minutes for a 200 mm wafer, 1 mm resolution, one fixed wavelength or < 60 minutes for a 200 mm wafer, 1 mm resolution, wavelength scan

# Temperature range up to 150°C

**Spatial resolution** 0.1 mm

**Diameter measurement spot** O.5 mm default setting

#### Reliability

modular and compact bench top instrument and monochromator configuration for high reliability and uptime > 99%

Repeatability of SPV measurement < 2%

Fast and contact less investigation of charge separation processes, electronic transitions and diffusion lengths



Detection of photogenerated carries separated in space







**4H-SiC 4-inch wafer** epitaxial illumination at 375 nm

Si wafer illumination at 980 nm



4H-SiC 6-inch wafer Surface and subsurface quality with patterns seen from polishing wheel, measured with 375 nm laser diode

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# HR-SPS map

# Technical specifications

#### Sample size

5 x 5 mm<sup>2</sup> to 300 mm, square wafers, round wafers or arbitrary geometry, 10 µm to 25 mm thickness

#### Measurable properties

Surface Photovoltage, time-resolved and amplitude in a temperature range from 0°C and up to 150°C

#### Excitation fixed λ

select up to four different wavelenghts from 255 up to 1550 nm

#### Excitation variable λ

select up to four different wavelenghts from 255 up to 1550 nm, 375, 450 and 980 nm are default

Laptop or PC requirements Windows 11 or latest, .NET Framework update, 2 Ethernet ports

#### Other materials

wide bandgap materials, photoactive materials, radiation detection materials, tandem solar sells and oxides

Power requirements 100-250V AC, 5A

Dimensions 680 x 380 x 450mm without monochromator

#### Weight ca. 65 kg

without monochromator

#### Certification

manufactured under ISO 9001 guidelines, CE conform







# Configuration options

- → Spot size variation
- → Reference wafer
- → Integrated heating stage
- → Wide range of lasers and light emitting diodes  $\rightarrow$ 
  - Laser-driven light source and Halogen lamps

# SPSstudio

#### User-friendly and advanced operating software with:

- → Time-resolved SPV signal output, SPV signal height, time constant (incl. minority carrier lifetime, diffusion, drift and trapping)
- Export and import functions
- → Multi-level user account management
- → Overview over all performed measurements
- → Sample parameter input
- → Single point measurements e.g. injection dependent measurements
- → Raw data access
- → Mapping options
- → Recipes
- → Package of analysis functions; for instance, Transient Analytic Software - stretched exponential fit with up to 5 parameters
- → View of line scans and single transients



High purity semi-insulating 4H-SiC substrate with ultra-low point-defect concentration, measured with DPM100 - Double Prism Monochromator



HR-SPSmap with DPM100 double prism monochromator for spectral resolved SPV/SPS measurements

# Sophisticated Material Research & Development

- → Bandgap engineering in Perovskites (example right)
- → Water splitting cells using photocatalytic materials
- Surface & bulk contamination in semiconductor materials



SiC Epitaxial layer quality analysis



MDpicts for defect level charaterization



Laser Power 2 mW SPV electrode without glas 1 mm sp

SPV<sub>avg</sub> ~ 860 mV



SPV.... ~ 240 mV



Courtesy of Prof. Dr. Eva Unger, Helmholtz-Zentrum Berlin für Materialien und Energie, Germany

# **Relevant** products