Freiberg Instruments

MDpicts

Microwave Detected Photo Induced Current Transient Spectroscopy

for contactless and destruction free temperature dependent measurement of minority carrier lifetime and electrical characterization of bulk and interface trap levels of semiconductors

Si | compound semiconductors | oxides | wide bandgap materials | perovskites | epitaxial layers

[CdTe | InP | ZnS | SiC | GaAs | GaN | Ge | HgCdTe]

Fundamental Research & Development on Semiconductor Materials

Sensitivity: highest sensitivity for electrical defect characterization

Temperature range: liquid nitrogen (77 K) up to 500 K. Optional: liquid helium (4 K) or higher temperatures

Range of decay constants: 50 ns to several ms

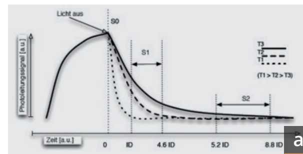
Contamination determination: measurement of fundamental trap level properties: activation energy and capture cross section of traps, temperature and injection dependent lifetime measurements

Repeatability: > 99.5%, Measurement time: < 60 minutes. Liquid nitrogen consumption: 2 l/run

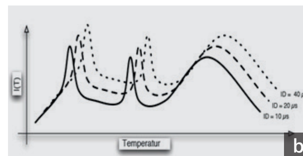
Flexibility: select from different wavelengths from 365 nm up to 1480 nm for materials of different kinds

Accessibility: IP based system allows remote operation and technical support from anywhere in the world

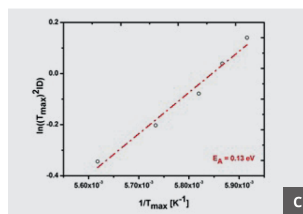
+ semiconductor characterization and development
+ for material quality improvement
+ defect identification possible: activation energy, capture cross section



a. Temperature dependent carrier emission transients



b. Box car evaluation with varying ID



c. Arrhenius plot

Configuration options

+ Contacts for conventional PICTS measurements
+ Contacts for DLTS (additional capacitance bridge required)
+ LBIC at liquid nitrogen temperature with and without spatial resolution (5 µm)

Ceramic sample holder with contacts for conventional PICTS measurements

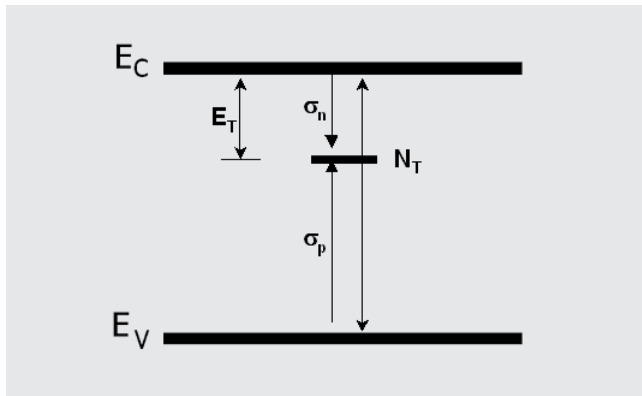
CZ-Si wafer placed over the resonator cavity for microwave detected PICTS measurements

Background

MDpicts is an advancement of conventional Photo Induced Current Transient Spectroscopy (PICTS). It is contactless and has a higher sensitivity, opening new fields of applications on a variety of semiconductors. This technique is sensitive to defects acting as carrier traps while the widely spread method DLTS gives more information about the dominating recombination center in the material.

Every defect is defined by:

- Activation energy E_T
- Capture cross section σ_p and σ_n
- Defect density N_T



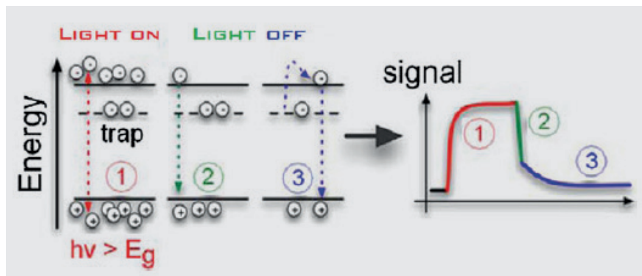


Fig. 1: Physical processes and their corresponding signal parts in MD-PICTS: (1) generation and trapping of carriers, (2) fast recombination process, (3) thermal reemission of trapped carriers.

Publications

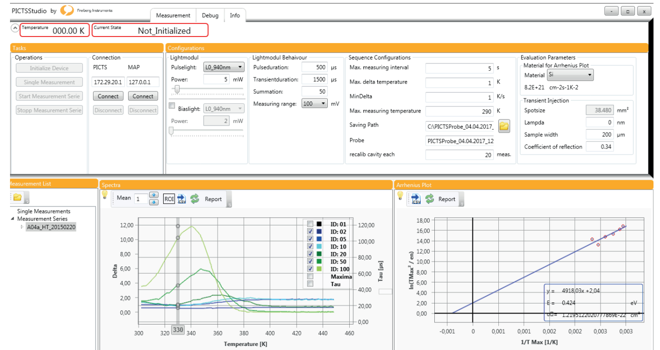
B. Berger, N. Schüler, S. Anger, B. Gruendig-Wendrock, J. R. Niklas, K. Dornich, physica status solidi A, 1-8

For more publications, please visit: *www.freiberginstruments.com/upcdmdp/publications.html*

PICTSStudio

The user-friendly operating software offers features for defect investigation like

- Operation and configuration area
- Results/charting
- View of single transients and temperature dependent curves
- Automated evaluation of activation energy and capture cross sections via Arrhenius plot



Technical specifications

Sample size	up to 20 x 20 mm, down to 5 x 5 mm
Resistivity	0.2 – >10^{10} Ohm cm
Conduction type	p, n
Measureable properties	lifetime – µPCD/MDP (QSS), photoconductivity and emission constants
Excitation	select from different wavelengths from 365 nm up to 1480 nm. 980 nm (default)
Laptop or PC requirements	Windows 7 or latest, .NET Framework update, 2 Ethernet ports
Power requirements	100 – 250 V AC, 5 A
Dimensions	450 x 300 x 330 mm
Weight	ca. 25 kg
Certification	manufactured under ISO 9001 guidelines, CE conform

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