Improved defect spectroscopy by in situ light illumination and electric field variation at PLEPS

R.Helm,* W.Egger, M. Dickmann, and G. Dollinger

Institut für Angewandte Physik und Messtechnik, Universität der Bundeswehr München, Werner-Heisenberg-Weg 39, D 85577 Neubiberg, Germany

The **P**ulsed **L**ow **E**nergy **P**ositron **S**ystem **PLEPS** at the intense positron source NEPOMUC at the FRM II in Munich allows to measure positron lifetime spectra using a monoenergetic positron beam of variable energy between 0.5-20 keV [1]. PLEPS is a unique tool to investigate open volume defects in a large variety of material systems, e.g. in wide band-gap semiconductors or in thin-layer structured semiconductors and insulators [2-4].
Defect identification in semiconductors and insulting materials is a challenging task: One encounters a wide variety of different defect types, often with very similar positron lifetimes. The defects may have different charge states, negative, neutral or positive. In addition, samples may contain (multiple) thin layers, interfaces or internal surfaces, which can be narrower than the positron implantation profile.
To meet the challenges for defect identification in those ever more complex materials several modifications of PLEPS are necessary: To change the charge state of defects by illumination a broad bandwidth arc-lamp in combination with a filter system which covers a spectral range from 0.2-2.5µm will be installed at PLEPS. Electrical fields affect the positron motion in materials and can be used, e.g. to drive positrons towards or away from interfaces [5]. To apply electrical fields to the sample and to measure and manipulate currents and voltages during positron lifetime measurements, a new type of sample holder is currently developed, the sample target station has to be mechanically modified and electrically adapted.

References

[1] P. Sperr *et al*, *Applied Surface Science*, **255** 35-38 (2008).
[2] A. Uedono *et al*, *Journal of Applied Physics*, **123** 155302 (2018).
[3] F.V.E. Hensling *et al.*, *Scientific Reports* **8**:8846 (2018).
[4] W. Shi *et al.*, *Physical Review Letters*, **121**, art. no. 057401 (2018).
[5] A. Uedono *et al.*, *Physics Letters A*, **133** 82-84 (1988).

*Corresponding author, Email: ricardo.helm@unibw.de