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Study of irradiation-induced primary defects in wide bandgap semiconductors

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Abstract :

The Department of Physics at the University of Pretoria (UP) comes with a long tradition of studies of the electronic properties of semiconducting materials which are mostly determined by the incorporated defects. Therefore, these studies split into two parts: (1.) the introduction and (2.) the detection of defects. At UP lattice defects are introduced by irradiating the samples with high-energy proton or alpha-particle beams using a Van-de-Graaf accelerator. On the other hand the detection and investigation of electronic states introduced by these defects into the bandgap of the material is done by space charge spectroscopic measurements (SCSM) like deep-level transient spectroscopy (DLTS).The setup consists of a cryostat which is aligned with the beam-line of the Van-de-Graaf accelerator. It enables us to conduct the irradiations at low temperatures (20K) and to study primary, irradiation-induced defects in-situ beforethey anneal out. In this paper data measured on proton-irradiated zinc-oxide thin-film Schottky diodes will be presented. After the irradiation at 20K the samples became highly resistive due to primary defects. The capacitance-temperature scan of these samples indicated that a significant fraction of the irradiation-induced defects annealed out at about 120K. A subsequently conducted DLTS measurement revealed that furthermore a deep-level E4 which is stable even up to room-temperature was introduced.In wide band-gap semiconductors deep primary defect states cannot be addressed by thermal SCSM. However, they can be studied using photo-ionization techniques. Therefore, we are presently adding an optical setup to the existing facility. This worldwide unique setup will enable us to study the formation and annealing-out characteristics of primary defects with states in the entire bandgap of wide bandgap semiconductors. Some aspects of the experimental setup and preliminary experiments will be presented.

Award :

No

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Paper :

Yes

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