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On the T2 Deep-Level in Zinc Oxide Thin Films

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Abstract content
   (Max 300 words)

Defects in semiconductor crystals locally break the crystal symmetry and often introduce electronic states into the bandgap. These influence the concentration of free charge carriers and thus macroscopic properties such as conductivity and optical absorption of the material. Zinc oxide (ZnO) is a transparent, wide-bandgap semiconductor which is dealt as a promising material for future opto-electronic devices operating in the near UV. However, none of these applications will materialize without understanding and control of its defects. Up to now different groups have detected a set of electronic defect states in ZnO samples by space charge spectroscopic measurements (SCSM), e.g. deep-level transient spectroscopy (DLTS). Their samples were differently grown single crystals or thin films and often underwent a post-growth treatment. Usually the space charge region was provided by Schottky contacts. However, the properties of most electronic defect states in ZnO are still not well understood.
In this study SCSM conducted on differently treated ZnO thin film Schottky diodes often revealed the presence of a deep-level labelled T2. The concentration of T2 was significantly increased when the samples were either annealed under reduced oxygen partial pressure or zinc ions were implanted into the samples. This suggests that T2 preferentially forms under zinc-rich conditions.
The talk will focus on the investigation of the astonishing properties of the T2 level by different SCSM. By DLTS the thermal activation energy, E_a, and the electron capture cross-section of T2 were determined. It was found that both quanta strongly depend on the T2 concentration in the sample. While E_a=280meV for low T2 concentrations, it decreases to 170meV with increasing concentration. Furthermore the photo-ionisation cross-section spectrum of T2 was measured. The possibility to photo-ionise T2 was used to measure its concentration profile in the samples employing optical capacitance-voltage measurements. Finally a tentative microscopic model for T2 explaining the experimental observations is proposed.

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