## Defects in ZnO/Si and ZnO NR/Si heterojunctions

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Recently zinc oxide has been widely investigated, due to its potential application in optoelectronics and photovoltaics [1]. However, the technology of production the ZnO layers and nanostructures is still being developed. The atomic layer deposition (ALD) method is acclaimed by its simplicity, precision and low costs of deposition. At the same time, it can be used to initiate the growth of ZnO nanorods (NR) using the hydrothermal method. In this work the defects in the junctions based on ZnO layers and ZnO NR on silicon substrate were investigated to allow further optimization.

The current-voltage and capacitance-voltage versus temperature measurements were performed on n-type ZnO/p-type Si and n-type ZnO NR/p-type Si heterojunctions to establish their quality and basic parameters. It was concluded that the depletion region extends mainly in the ZnO layer. Using the deep level transient spectroscopy (DLTS) technique the deep levels in the junctions were investigated. To exclude the defects present in the substrate, the Schottky diodes on p-type silicon were also studied by means of DLTS.

The levels connected with the defects in bulk ZnO were found. Their main parameters (activation energy Ea = 0.3 eV, capture cross section  $\sigma = 5 \times 10^{-13}$  cm<sup>-2</sup>) were obtained and their origin was discussed. The defects present on the surface between the ZnO and Si were also observed. As they can be the source of recombination losses in the solar cells, it is important to minimize their concentration.

The ZnO NR/Si structures seems to be a better candidate for solar cells, as their electrical properties are better and the concentration of surface defects is lower.

[1] R. Pietruszka et al., Sol. Energ. Mat. Sol. Cells. 143, 99-104 (2015).

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