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DETERMINATION OF CHARGE CARRIER DENSITY IN ZINC OXIDE NANORODS PREPARED BY CHEMICAL SPRAY

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Nanostuctured ZnO layers comprising hexagonal nanorods (ZnO_{NR}), prepared by chemical spray [1], were studied. Optical transparency and light scattering ability due to high internal surface area makes ZnO_{NR} suitable for solar cell window layer application [2].

The aim of the study of ZnO_{NR} was the determination of the charge carrier density in ZnO_{NR} layers. ZnO_{NR} layers are highly c-axis orientated [1] and indicating high resistivity according to preliminary measurements. Therefore, an unconventional method was developed to determine the carrier density in ZnO_{NR}: (1) the C-V characteristics of ZnO_{NR}/Hg Schottky barrier was obtained in order to determine the active area of the ZnO_{NR}/Hg contact via a proposed model (Fig.1) for the capacitance of ZnO_{NR}/Hg Schottky barrier; (2) Mott-Schottky plot of the C-V characteristics was applied in order to determine the carrier density.

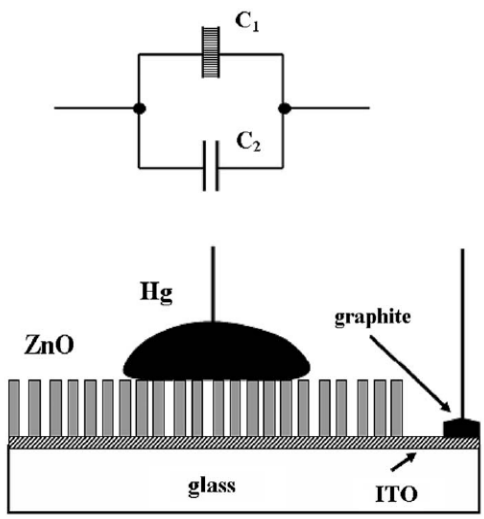

Fig. 1: A sketch of the Hg contact applied to the ZnO nanorod array and a model of capacitance, where C1 is the capacitance caused by the active area and C2 is the capacitance caused by an air gap.

The thickness of the ZnO_{NR} layer was determined by SEM and the series resistance of the ZnO_{NR} layer was calculated from I-V characteristics of the ZnO_{NR}/Hg barrier. Relatively low carrier densities in the order of 10^{15} to 10^{16} cm^{-3} were determined in the ZnO_{NR} layers. The origin of the charge carriers in ZnO_{NR} is related to the intrinsic defects of ZnO_{NR}, most likely oxygen vacancies. ZnO_{NR} doping is needed in case higher carrier densities are required.

References

1. M. Krunks, T. Dedova, I. Oja Açik. Thin Solid Films **515** (2006) 1157–1160

2. M. Krunks, A. Katerski, T. Dedova, I. Oja Acik, A. Mere. Solar Energy Materials & Solar Cells **92** (2008) 1016– 1019