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Research Article

Shrinkage Effects of the Conduction Zone in the Electrical Properties of Metal Oxide Nanocrystals: The Basis for Room Temperature Conductometric Gas Sensor

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Abstract

The influence of charge localized at the surface of minute metal oxide nanocrystals was studied in WO3 and In2O3 nanostructures, which were obtained replicating mesoporous silica templates. Here, it is shown that the very high resistive states observed at room temperature and dark conditions were originated by the total shrinkage of the conductive zone in the inner part of these nanocrystals. On the contrary, at room temperature and under UV illumination, both photogenerated electron-hole pairs and empty surface states generated by photons diminished the negative charge accumulated at the surface, enlarging the conductive zone and, as a consequence, leading to a reduction of the electrical resistance. Under these conditions, empty surface states produced by UV light reacted with oxidizing gaseous molecules. The charge exchange associated to these reactions also affected the size of the inner conductive zone, and leaded to a new steady-state resistance. These chemical, physical and geometrical effects can be used for gas detection, and constitutes the basis for developing novel room temperature conductometric gas sensors responsive to oxidizing species.