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TOPIC: INVESTIGATION OF ELECTRICAL AND OPTICAL PROPERTIES OF NOVEL ZnO NANO STRUCTURES

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ABSTRACT

ZnO nanostructures (nano particles and nano rods) had been synthesized using physical vapour condensation method.SEM had been used for topographical characterization of the ZnO nanostructures. The morphology as well as the crystallographic and compositional information had been obtained using TEM.For optical characterization UV-spectrometer is used. X-ray diffraction technique was employed to verify the structure of the grown nanostructures.

The nano-particles of ZnO were grown at a low temperature of 400°C. These nanoparticles were almost spherical in shape and the size varies from 40 nm to 100nm. The growth mechanism of these nanoparticles involves the vaporization of material into a low density gas by resistive heating and the vapors migrate from the hot source to liquid nitrogen cooled substrate.

In case of optical properties of the nanoparticles, it was suggested that the absorption mechanism was due to direct transition. The value of the optical band gap comes out to be 3.54 eV. It had been observed that the absorption coefficient increased exponentially with the increase in photon energy. The value of Urbach energy (E_U) was also calculated using the slope of the plot ln σ vs. photon energy and it comes out to be 805.8 meV. Electrical conduction mechanism was successfully explained with thermally activated transport for the temperature range of 450-300K. For thermally activated process, the calculated value of activation energy is 0.35 eV. The present sample exhibits *n*-type semiconducting behavior originating from native defects, mainly of Zn interstitials or oxygen vacancies.

The typical diameter of ZnO nanorods obtained was in the range of 80 nm–150 nm and the length was of the order of several hundreds of nanometers. The crystallinity and phase identification of the grown ZnO nanostructures have been ascertained by XRD.

The resistivity of ZnO was determined from current voltage curve measured for different temperature. For all studies a linear dependence typical of ohm's behavior was observed (the conductivity as a function of the temperature).The conductivity was directly proportional to temperature. Curve exhibits a minimum of conductivity at room temperature. The conductivity increases with increase in the temperature and the increase in the conductivity by a factor of 10 in compare to the previous value.The electrical conductivity changes in ZnO and other n type semiconductor under photo reduction in subsequent exposure in oxidizing gas atmosphere were in general explained by the formation and annihilation of oxygen vacancies at the metal oxide surface.