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Optical and electrical properties of ZnTe nanostructures

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Zinc Telluride (ZnTe) is one of the more common direct band gap semiconducting materials used in optoelectronics. It is used for the development of various semiconductor devices, including blue LEDs, laser diodes, solar cells [1] and components of microwave generators.

Here we report the synthesis of ZnTe nano-material by soft chemical route [2] using mercaptoethanol as a capping agent. X-ray diffraction shows that the prepared sample belongs to hexagonal structure (Figure 1a). Transmission electron microscope analysis was done to calculate the average particle size. The band gap of the material is found to be 3.9 eV (Figure 1b) which is greater than the band gap of bulk ZnTe (2.2 eV) [3]. This may be due to the quantum confinement effect.

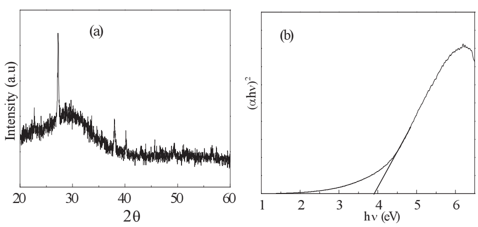

Figure 1 (a) X-ray diffraction pattern of ZnTe. (b) UV-Visible absorption spectrum for direct transition [$(\alpha h\nu)^2$ vs. hν].

The photoluminescence emission spectra of the sample measured at various excitation wavelengths show that the emission spectra depends on the exciting photons. Impedance spectroscopy is applied to investigate the dielectric relaxation of the sample at room temperature in a frequency range from 42 Hz to 1.1 MHz. The frequency dependent conductivity spectra are found to follow the double power law as given by eq. 1,

$$\sigma(\omega) = \sigma(0) + A_1\omega^{n_1} + A_2\omega^{n_2} \qquad (1)$$

where σ(0) is the frequency independent conductivity. The exponents n1 and n2 correspond to the low and high frequency slope regions which vary from 1 to 2 and 0 to 1 respectively. Since two plateaus are present in the conductivity spectra, we have used the double power law equation to explain the experimental data. The best fit of the conductivity spectra are shown in Figure 2 by solid lines. According to the Jump-Relaxation model at low frequencies, the electric field cannot perturb the hopping conduction mechanism of charged particles, hence the conductivity is approximately equal to the dc value and the hopping of charged particles from one localized site to another results in long range translational motion. But in the higher frequency range the effect of electric field is dominant and ac conductivity increases with frequency.

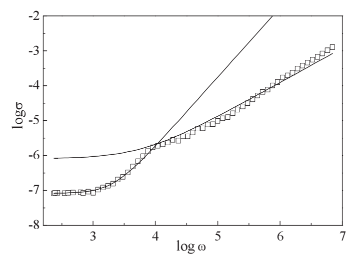

Figure 2: Log-log plot of frequency (angular) dependence of the conductivity of ZnTe at room temperature, where the *symbols* represent the experimental data and the *solid line* represents the fitting to the experimental data using Eq. (1).

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