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Pulsed laser deposited doped Cu₂O thin films for optical application

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Cuprous oxide, (Cu₂O) is a promising p-type semiconductor, finds applicability in a wide range of photo conversion devices. Pulsed laser deposition technique is employed to grow doped Cu₂O thin films. Doping mechanism of silver (Ag), aluminium (Al) and (Ag+Al) in Cu₂O thin films is illustrated in this report. The Al, Ag doped and (Al+Ag) co-doped Cu₂O targets are prepared by the solid state reaction method by mixing Cu₂O powder with Al₂O₃ and Ag₂O, powders respectively, in stoichiometric ratios. The doping profile of both Al and Ag in Cu₂O is kept 5%. For co-doped, it is 2.5% Al and 2.5% Ag in Cu₂O. An Nd:YAG laser operating at wavelength 355 nm and energy 100 mJ/pulse is used to ablate the targets of (Cu₂O:Al), (Cu₂O:Ag) and (Cu₂O:Al:Ag). X-ray diffraction analysis depicts the polycrystalline nature of the films, with a cubic crystal structure and having small crystallite size. UV-visible optical transmittance versus wavelength spectrum of these films describes low transmission i.e. 10-20%, due to the large absorption coefficient (α) for Cu₂O material. The large values of absorption coefficient enable the photovoltaic and optical applications of the Cu₂O films. The energy band gap of the films is determined using the Tauc's plot relation, shown in figure 1. The optical band gap is increased with doping and it varies in the range of 2.65–2.84 eV. The increased band gap of doped thin films is attributed to the substitution of Al and Ag ions for the oxygen ions. Due to this substitution, width of the valence band is reduced to enlarge the band gap. Room temperature current voltage (I-V) plot indicates low resistivity ($\rho \sim 10^{-2} \Omega\text{-cm}$) of the films. The obtained results are of high relevance and indicate potential applications of the grown thin films in devices such as solar cells, photo detectors and optical sources.

Biography

Gurpreet Kaur has completed her PhD in Physics at Indian Institute of Technology, Roorkee, India in 2016. She has been working as an Assistant Professor in Department of Physics at Dr. B. R. Ambedkar National Institute of Technology, Jalandhar since 2016. Her current research area of interest is "Synthesis of nanomaterials for optical device applications".

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