THERMAL ANNEALING AND UV INDUCED EFFECTS ON THE STRUCTURAL AND OPTICAL PROPERTIES OF CAPPING FREE ZNS NANOPARTICLES SYNTHESIZED BY CO-PRECIPITATION METHOD

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ABSTRACT

Capping free Zinc Sulphide nanoparticles were synthesis from aqueous solutions of Zinc Chloride ($ZnCl_2$) and Sodium Sulphide (Na_2S) in air at $70^{o}C$ by co-precipitation method. The as-prepared and annealed samples were characterized by X-ray diffraction (XRD), UV-Vis absorption, scanning electron microscope (SEM), transmission electron microscope (TEM) and selected area electron diffraction (SAED). Analysis of XRD pattern indicates that the as prepared and annealed samples up to $300^{o}C$ ZnS nano-crystallites have cubic zinc blend structure. Furthermore, annealing at $550^{o}C$, results in partial conversion of the initially cubic ZnS, to ZnS and ZnO Hexagonal phases as revealed by XRD patterns. SAED pattern for as-prepared ZnS reveals the polycrystalline nature. Furthermore, the lattice parameters determined from (XRD) and (SAED) patterns are in good agreement. Annealing of the ZnS nanoparticles in air in the temperature range, $150 – 550^{o}C$, leads to the increase in crystallite size from 2.14 to 18 nm accompanied by decrease in optical band gap (E_g^{opt}) from 3.98 to 3.3eV, for the as prepared and sample annealed at $550^{o}C$ respectively. Analysis of TEM and SEM Images indicates that the ZnS nanoparticles tend to be nearly spherically shaped with narrow size distribution. Different times UV irradiation of ZnS aqueous solution results in increase in optical energy gap with the irradiation time. The observed photo brightening is explained in terms of the formation of $ZnSO_4$ passivation layer via photon-assisted chemical reaction.

KEYWORDS: Annealing, Optical Absorption, Photo-Brightening, UV-Induced, XRD, Zns Nanoparticles