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Synthesis and characterization of cobalt sulfide nanoparticles by sonochemical methodMustafa B. Muradov^b, Ofeliya O. Balayeva^{a*}, Abdulsaid A. Azizov^a, Abel M. Maharramov^a,Lala R. Qahramanli^b, Goncha M. Eyvazova^b, Zohrab A. Aghamaliyev^b^a*Department of Chemistry, Baku State University, Z. Khalilov str., 23, AZ-1148 Baku, Azerbaijan*^b*Department of Physics, Baku State University, Z. Khalilov str., 23, AZ-1148 Baku, Azerbaijan***ABSTRACT**

Convenient and environmentally friendly synthesis of $\text{Co}_9\text{S}_8/\text{PVA}$, $\text{Co}_x\text{S}_y/\text{EG}$ and $\text{Co}_x\text{S}_y/3\text{-MPA}$ nanocomposites were carried out in the presence of ultrasonic irradiation by the liquid phase synthesis of the sonochemical method. For the synthesis, cobalt acetate tetrahydrate $[\text{Co}(\text{CH}_3\text{COO})_2 \cdot 4\text{H}_2\text{O}]$ and sodium sulfide ($\text{Na}_2\text{S} \cdot 9\text{H}_2\text{O}$) were used as a cobalt and sulfur precursor, respectively. Polyvinyl alcohol (PVA), ethylene glycol (EG) and 3-mercaptopropionic acid (3-MPA) were used as a capping agent and surfactant. The structural, optical properties and morphology of nanocomposites were characterized using X-ray diffractometer (XRD), Ultraviolet/Visible Spectroscopy (UV-Vis), Fourier-transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM). The optical band gap of $\text{Co}_9\text{S}_8/\text{PVA}$ is 1.81 eV and for $\text{Co}_x\text{S}_y/\text{EG}$ is 2.42 eV where the direct band gap of bulk cobalt sulfide is (0,78-0,9 eV). The wide band gap indicates that synthesised nanocomposites can be used in the fabrication of optical and photonic devices. The growth mechanisms of the Co_9S_8 , CoS_2 and Co_3S_4 nanoparticles were discussed by the reactions. The effects of sonication time and annealing temperature on the properties of the nanoparticles have been studied in detail.

Keywords: nanocomposites (NCs); sonochemical synthesis; optical properties; capping agent

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