Plasmonics. Vol. 20 (3), 2025, pages 1669 - 1683

Improved Physical Properties of Ag-Cu_2O Hybrid Structure Prepared Using Laser Ablation in Liquid Technique

Abstract

This work presents the preparation of Ag@ Cu_2O nano-crystals employing two methods, laser ablation in liquid and photo-ionization using UV radiation as a light source. The effect of Ag concentration on optical, electrical, structural, surface morphology, and other physical properties of Ag@Cu_2O crystal was carried out. This work provides an on-site technique for the homogeneous development of Ag NPs on Cu_2O surfaces, which involves the use of low-cost Ag salts as the source of Ag plasmonic nanoparticles. The Ag concentration was taken as a function of different chemical interaction times (5–25) sec that were used to adsorb the Ag nanoparticles (NPs) on the surface of the Cu_2O sample. The optical properties ensure the improvement of the prepared material with the presence of Ag plasmonic nanoparticle, where the estimated energy gap was found to be reduced from 1.9 to 1.66 eV, and a red-shift in the optical spectra has been recognized. The surface morphology obtained by SEM images ensured the formation of a fine, smooth, uniform structure, and revealed that Ag nanoparticles have quasi-spherical morphologies with an average particle size ranging from 62 to 32 nm, based on the immersion times. Structural properties proved the formation of cubic Cu_2O crystal centered at (110) diffraction plane. This was attributed to the Raman results. The optimum properties of Ag@Cu_2O were obtained at 15 s, reduction of the optical band gap to 1.8 eV, and additionally, it offered the highest merit rating (F.O.M.) with an electrical conductivity of 2.09 S cm^{-2}.

Keywords

Charge career properties; Cu_2O NPs; Optical properties; Pulsed laser ablation in liquid; Silver