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Synthesis and properties of polyamide-Ag_2S composite based solar energy absorber surfaces

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Abstract

Silver sulfide (Ag_2S), an efficient solar light absorber, was synthesized using a modified chemical bath deposition (CBD) method and polyamide 6 (PA) as a host material via solution phase reaction between $AgNO_3$ and $Na_2S_2O_3$. X-ray diffraction (XRD) data showed a single, α-Ag_2S (acanthite), crystalline phase present while surface and bulk chemical analyses, performed using X-ray photoelectron (XPS) and energy dispersive (EDS) spectroscopies, showed 2:1 Ag:S ratio. Direct and indirect bandgaps obtained from Tauc plots were 1.3 and 2.3 eV, respectively. Detailed surface chemical analysis showed the presence of three distinct sulfur species with majority component due to the Ag_2S chemical bonds and minority components due to two types of oxygen-sulfur bonds. Conductivity of the resulting composite material was shown to change with the reaction time thus enabling to obtain controlled conductivity composite material. The synthesis method presented is based on the low solubility of Ag_2S and is potentially green, no by-product producing as all Ag_2S nucleated outside the host material can be recycled into the process via dissolving it in HNO_3.

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