

Title: Mixed ligand complexes from coumarin motifs and dicyclohexyldithiooxamide for PbS and SnS binary semiconductor NPs

Joseph Adeyemi Adekoya[1,2], Olusola Pelumi Oyeku[1], Kehinde Olurotimi Ogunniran[1], Tolutope Oluwasegun Siyanbola, Cyril Osereme Ehi-Eromosele and Neerish Revaprasadu[2]

[1]Department of Chemistry, Covenant University, PMB 1023, Ota, Ogun 112, Nigeria
[2]Department of Chemistry, University of Zululand, Private Bag X1001, Kwadlangezwa 3886, South Africa

(E)-2-(1-(2-oxo-2h-chromen-3-yl)ethylidene)hydrazinecarbothioamide [H_3L^3] was prepared by the reaction of an intermediate (3-acetylcoumarin) formed by cyloaddition and cyclocondensation of ethyl acetoacetate and salicyaldehyde with thiosemicarbazide in ethanol. The metal complexes were then successfully synthesized in ethanolic solution of N,N'-dicyclohexyldithiooxamide and [H_3L^3]. TGA showed weight loss of about 60%, subdivided into two weight loss stages: the first stage occurred in the temperature range 150 - 300 ^oC, accounting 42% loss related to removal of hydrazinecarbothioamide derivative ligand, while the second occurred between 300 - 400 ^oC, 18% weight loss accounting for the dicyclohexyl derivative loss. Binary PbS and SnS nanoparticles were equally synthesized from their respective precursors (metal complexes) through solvothermal decomposition at 200 and 240 $^{\circ}C$ in oleylamine and were characterized by p-XRD, SEM-EDX, TEM and HRTEM. Pure cubic crystal phases of PbS NPs (galena) with space group of F m -3 m (ICDD# 96-901-3403) and orthorhombic SnS NPs (Herzenbergite) with P b n m space group (ICDD# 96-152-7227) were obtained. Their crystallite sizes varied with temperature, the average diameter for PbS nanoparticles at 200 °C being 38.5 ± 4.0 nm, and at 240 °C, 53.1 ± 6.9 nm appearing as agglomerated rod-shaped particles. Similarly, agglomerated SnS nanoparticles with an average diameter of 77.5 ± 13.9 nm were obtained at 200 °C, while at 240 °C, irregular triangular shaped particles with an average size of 525.1 ± 73.9 nm were formed. The PbS and SnS nanocrystals band-gap energies were 3.25-3.45 eV and 1.2-1.3 eV respectively in the optimum range for photovoltaic applications.

Biography

Dr. Joseph studied Analytical Chemistry at the Lagos State University, Ojo, Lagos, Nigeria and graduated with PGD, M.Sc degrees in 2002. He is an astute academic and research staff of

Inorganic Chemistry Unit, Covenant University, Nigeria. He received his Ph.D degree (Chemistry) in 2014 at the same institution. After one-year postdoctoral fellowship (2017 – 2018) supervised by Prof. Neerish Revaprasadu at the University of Zululand, KwaDlangezwa, South Africa he obtained the position of a Senior Lecturer at the Covenant University. He has published more than 36 research articles in Scopus and other related data bases indexed journals.

Presenting author details

Full name: Joseph Adeyemi ADEKOYA
Contact number: 2348056532188
Twitter account: JosephAdekoya
Linked In account: Joseph Adekoya
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