

Au-controlled enhancement of photoluminescence of NiS nanostructures synthesized via a microwave-assisted hydrothermal technique

Ella Cebisa Linganiso a,b, Bonex Wakufwa Mwakikunga a,e,n, Sabelo Dalton Mhlanga d,

Neil John Coville b,c

a DST/CSIR Nanotech Innovation Centre, National Centre for Nano-structured Materials, Council for Scientific and Industrial Research, PO Box 395, Pretoria 0001, South Africa

b Molecular Sciences Institute, School of Chemistry, University of the Witwatersrand, Private Bag 3, Wits, 2050 Johannesburg, South Africa

c DST/NRF Centre of Excellence in Strong Materials, University of the Witwatersrand, Private Bag 3, Wits, 2050 Johannesburg, South Africa

d Department of Applied Chemistry, University of Johannesburg, PO Box 17011, Doornfontein, 2028 Johannesburg, South Africa

e Department of Physics and Biochemical Sciences, The Polytechnic of the University of Malawi, Private Bag 303, Chichiri, Blantyre 0003, Malawi

Abstract

Nickel sulphide (NiS) nanostructures decorated with gold (Au) nanoparticles (NPs) were synthesized via a microwave-assisted hydrothermal technique. Binary phase NiS (α and β) crystalline nanostructures, bare, and decorated with Au NPs were obtained and confirmed by X-ray diffraction (XRD) studies. TEM analysis revealed that the NiS nanostructures were of various shapes. A quantum confinement effect was confirmed by the blue shift PL emissions and high optical energy band gap observed for the as-synthesized sample. A threefold light emission enhancement due to Au NP coatings was obtained when Au metal NP decoration concentrations was varied from 1% to 10%. These enhancements were attributed to the surface plasmon resonance (SPR) excitation of the surface decorated metal NPs which results in an increased rate of spontaneous emission. The PL enhancement factor was observed to vary at different NiS emissions as well as with the size of the Au NPs. The effect of metal NP decoration on the PL emission of NiS is to the best of our knowledge, presented for the first time.