Synthesis and characterization of castor oil and ricinoleic acid capped metal sulfide semiconductor nanoparticles using heterocyclic metal dithiocarbamate complexes as single source precursors

Ginena Bildard Shombe

Master of Science (Chemistry)

University of Dar es Salaam, College of Natural and Applied Science,
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The synthesis and characterization of CdS and PbS semiconductor nanoparticles capped with green renewable materials; castor oil and ricinoleic acid is reported. The materials were synthesized from thermal decomposition of their corresponding piperidine and tetrahydroquinoline metal dithiocarbamate complexes as single source precursors. Different reaction parameters such as time, temperature and the type of dispersing solvent were varied to obtain particles with different properties and morphology. The complexes were thermolyzed at temperatures varying from 190 °C to 300 °C in castor oil and ricinoleic acid. To assess the influence of using greener dispersing solvents on the properties of the resultant particles, Tri-n-octylphosphine (TOP) was also employed in the synthesis. All particles were found to be in the nanosize regime as determined from TEM and XRD analyses. The Vis spectra of the synthesized materials showed a blue shift relative to the peakabsorptions of their bulk counterparts indicating quantum confinement effects and hence the synthesis of nanometric materials. Photoluminescence spectra of CdS nanoparticles also revealed quantum confined relatively broad emission peaks. Time did not seem to have an effect on the properties of the synthesized materials as little/no changes were observed in the materials produced after 30 minutes, 1 hr and 2 hrs of the reaction time in both cases. The effect of temperature, type of capping material, dispersing solvent and complex used was however significant. Oval-short rods and spherical shaped CdS nanoparticles with average sizes ranging from 10 to 22 nm were obtained. Dendritic, multi-branched, spherical, cubic and rod shaped PbS nanoparticles with various sizes were obtained. IR analysis confirmed that all synthesized materials were successfully capped by castor oil and ricinoleic acid.