Abstract

Semiconductor nanostructures are attractive due to their intriguing optical and electrical properties for potential applications in various quantum devices. Chalcogenide semiconductors have drawn considerable attention for their applications in semiconductor lasers, light emitting diodes, photovoltaic cells, display devices, biological and chemical sensing. The present research study is concerned with the growth and characteristics of sulfide and selenide based chalcogenide nanostructures for their possible applications in photovoltaic, photo-sensing and charge storage devices. The growth of mono dispersed, spherical shaped cadmium selenide (CdSe) quantum dots with controlled particle size, using phosphine-free and nontoxic chemicals, has been investigated in details. The properties of CdSe QDs/ conducting polymer photovoltaic devices have been found to depend on the size as well as the loading of the CdSe nanocrystals. A highly selective, room temperature chloroform vapor sensor has been fabricated using the above active material. The recovery time of the sensor could be improved on illumination with a monochromatic light of 600 nm, due to the photo-induced enhancement of charge transfer in nanocomposites. Quantum confined CdS nanoparticles have been grown on multi-walled carbon nanotube (MWCNT) surfaces by a chemical process. MWCNT-CdS nanostructures embedded in *Bombyx mori* silk protein matrix have shown the charge storage behavior akin to floating gate memory, which is attractive for potential applications in next-generation flexible, non-volatile flash memory devices for biocompatible electronics. The synthesis of ternary semiconductor, Zn-doped copper sulphide (CZS) nanoballs and its attachment on MWCNT from a single molecular source has been demonstrated. Superior hysteresis in I-V characteristics has indicated the bipolar resistive switching characteristics at low ‘SET’ and ‘RESET’ voltages with a high switching ratio in CZS nanoballs anchored with MWCNTs. The device appears to be useful for applications in nanoscale memory devices. Further, the properties of the quaternary semiconductor compound, copper zinc tin sulphide (CZTS), synthesized by chemical method have been studied for their efficacy in inorganic and hybrid solar cell applications.

Keywords: CdSe QDs, Photoluminescence, Hybrid solar cell, Floating gate memory, Resistive switching memory, CZTS