Abstract

Semiconducting materials are receiving considerable amount of research interest due to their wide range of applications. The physical/chemical properties of semiconducing micro/nanomaterials are strongly influenced by their dimensionality morphology. Hence, it is necessary to devise simple wet chemical methods to fabricate some useful semiconducting materials with diverse morphology. Therefore, the present work is focused on preparation, characterization and applications of semiconducting materials comprising of group of Group I-VI semiconductor (CuS), Group II-VI (CdS and ZnS), Group IV-VI (PbTe), Group VI-VI (MoS_2), and of Group VI (Se and Te).

In this regard, Se, Te, CdS, CuS and ZnS having diverse set of morphology have been synthesized from decomposition of morpholine-4-carbodithioate (MCDT) complex of Se, Te, Cd, Cu and Zn as single source precursors respectively. In case of Se and Te water-THF mixture is used as solvent for solvothermal decomposition of MCDT-Se/Te complex to form different morphology such as microflower, micro/nanorods, micro/nanoparticles. The effect of dielectric constant of media, temperature and soft template on morphology is studied. CdS and CuS are synthesized in lotus like microflower, hierarchical star and nanoparticles morphology. Subsequently, these are used as photocatalytic degradation of aqueous solution methylene blue (MB) and morphology dependence of % degradation has been established. In addition, graphene nanocomposites of CdS and CuS are used in effective water purification in terms of efficient photodegradation of toxic dye and removal of heavy metal ions from contaminated water.

Ball shaped MoS_2 nanoparticles are successfully synthesized by simple chemical reflux method followed by annealing under inert atmosphere. These particles are successfully used as filler in polysulphide modified epoxy resin (PSER) in order to investigate simultaneous improvements in mechanical, tribological and thermal properties. Our studies show that ball shaped MoS_2 filled PSER composite show superior improvements in comparison to neat PSER. Moreover, such improvements are far superior in comparison to that when synthetic MoS_2 used as filler in the same matrix.

We have also successfully synthesized PbTe nanorods by simple hydrothermal technique, in presence of different templates. These studies show that the diameter of the rods dependent on the nature of the templates.

Key words: Semiconductor, Diverse morphology, Ball shaped MoS_2, CdSmicroflower, CdS/Graphene, ZnS/Graphene, Removal of Cd(II) and Pb(II).