SnS Colloidal Nanocrystals: Synthesis, Optical and Electronic Properties

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Colloidal nanocrystals (NCs) are among the most promising candidate for the next generation solution processable electronic and optoelectronic device. The quantum confinement phenomena offer a tunability for electronic and optical properties; size-dependent band gap. The investigations and utilizations of metal chalcogenide NCs such as Lead Sulfide (PbS), Lead Telluride (PbTe), Mercury Telluride (HgTe) have demonstrated many interesting properties (e.g. solar cells, photodetectors, etc.).[1,2] However, their high degree of toxicity has become a serious issue. Tin chalcogenide offers merits of nontoxicity, low-cost and earth-abundant. In bulk form, it is known as semiconductor with excellent optical and electrical properties. To date, thin-film solar cells and single crystal thermoelectric based on tin chalcogenides (i.e. Tin Selenide (SnSe), Tin Sulfide (SnS), etc.) have been shown to exhibit high performances.[3] These outstanding results stimulate exploration of the properties of these material in the nanoscale size. However, the synthesis of thick class of NCs with small enough size to be in quantum confinement regime is still a significant challenge. Here, we demonstrate a modified solution-process[4] to synthesis SnS colloidal NCs with size only few nanometers. The SnS colloidal NCs with size less than its Böhr exciton radius (7 nm) is made in solution using Tin Chloride ($SnCl_2$) and Thioacetamide (TAA) in the presence Oleic Acid. X-ray diffraction (XRD) indicate that SnS NCs are well crystallized. XPS analysis confirms the SnS stoichiometry and the absence of impurity. The UV-Vis measurement suggests that SnS NCs absorbed almost the entire visible range and show very high absorption coefficient. Studies on the photoconductivity of the assemblies of these NCs will be discussed as well. These findings open up potential of SnS colloidal NCs to be used in optoelectronic applications such as solar cells, photodetector, and many other energy harvesting devices, etc.

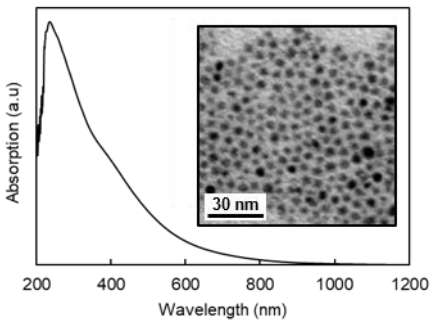

Fig. 1. Absorption spectra of as-synthesis SnS NCs. (Inset) TEM Images of SnS NCs.

References

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