Seminar

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Institute for Plasma Research

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Title: Exploring Tin-Selenide for Optoelectronic and Thermoelectric Applications

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Date: 13th December 2024 (Friday)

Time: 03:30 PM

Venue: Seminar Hall, IPR

Abstract

With recent advancements in technology miniaturing devices are required to open the aspect of the thin film research area. Materials can be used to detect the presence of the photons and to convert the photon's energy into electrical energy. Detection of photons opens a new door to applications like optical communication, weather forecasting, automatic sensors in defense sectors, spectroscopy, imaging in the medical field, etc. As far as concerned with the conversion of the photons, these materials can be applied in solar cells for sustainable and green energy production. It is one side of the coin, as whatever energy is consumed in daily life based on non-renewable source engines is wasted in heat. This wastage causes an economic loss and increases the rate of depletion of natural resources. On the other hand, 87 % of the energy of the world comes from fossil fuels. Out of that 70% of the energy is wasted mainly in the form of heat. This fact has forced scientists to focus on improving the sustainability of the harnessed energy which may extend the reserve depletion time of the natural resources as well. Thermoelectric materials can be deployed for this purpose.

Metal selenides are a new class of emerging thermoelectric and optoelectronic materials due to their low thermal conductivity, average electronic transport properties, and high absorption coefficient, respectively. The present market of thermoelectric is dominated by telluride and lead-based materials in low and medium temperature ranges, respectively. SnSe is one of the metal selenides that offer the highest zT among bulk (zT 3.1 at 783 K). Both SnSe and $SnSe_2$ are predicted to be very high zT and still can achieve further improvement. It is much less explored in the film aspect and still lags behind bulk by a big margin. Nanocomposite and energy filtering of carriers to decouple the electronic and thermal transport and low energy carriers are promising strategies explored recently. Due to their high absorption coefficient, and band gap in the desired range, these materials can be explored as good optoelectronic ones. There is already good track progress in the solar cell application of metal selenides like CZTSe, and Sb_2Se_3. These materials offer competitive applications in other domains like memory switching devices, photo-electro-chemicals, gas sensors, topological insulators, and battery applications. So, it become ubiquitous to explore these materials as futuristic materials.