All Inorganic $CsSnI_3$ Perovskite based Thermoelectric devices for Waste Heat Management

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The conversion of waste heat into usable electrical energy under the Seebeck effect is getting attention as a potential energy harvesting system. Thermoelectric devices explore the waste heat into usable electricity to fulfill and add the renewable energy need, wherein their performance is evaluated by a dimensionless thermoelectric figure ($ZT=S^2.\sigma.T.k^{-1}$), where Z is figure of merit, T is absolute temperature, S is Seebeck coefficient, σ is electrical conductivity and k is thermal conductivity, of the concerned thermoelectric material.

Recently, all inorganic Lead-free Perovskite based material $CsSnI_3$ has attracted significant attention in the solar research field due to their environment-friendly properties. They offer solution processed easy and cheap way of fabrication. The $CsSnI_3$ adopt polymorphic phase and exist in Pnma space group B-γ orthorhombic form at ambient temperature.[1] Despite considerable research in photovoltaics, however, the fundamental study of thermal transport in $CsSnI_3$ thin film is still lagging.

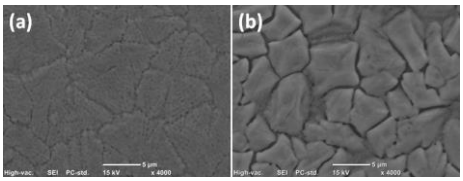

Figure 1: Surface morphology of grown $CsSnI_3$ film used in fabrication of thermoelectric device (a)without antisolvent (b) with antisolvent

Here, we fabricate the thermoelectric devices in the structure $Al_2O_3/CsSnI_3/MoO_3/Au$, wherein the $CsSnI_3$ film is grown using a solution processed single step process with or without toluene as an antisolvent. The use of antisolvent affect the crystallization process of grown film and different surface morphology is observed (Fig. 1). The grown film morphology influences the phonon-phonon interaction and thermoelectric properties are affected. We used differential 3ω method to measure the in-plane thermal properties of grown $CsSnI_3$ thin films, whereas the surface morphology and its effect on thermoelectric properties are studied in detail which will be discussed in the conference.

1) I. Chung, J.-H. Song, J. Im, J. Androulakis, C. D. Mallikias, H. Li, A. J. Freeman, J. T. Kenney, and M. G. Kanatzidis, *J. Am. Chem. Soc*., 2012, 134, 8579.