Enhancement of thermoelectric properties of hybrid-halide perovskites thin films using anti-solvent

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The conversion efficiency of thermoelectric material is quantified by figure of merit ZT ($=\sigma S^2T/\kappa$: σ is electrical conductivity, S is Seebeck coefficient and κ is thermal conductivity). $CH_3NH_3SnI_3$ ($MASnI_3$) single crystals have intrinsic high value of Seebeck coefficient due to charge-carrier mobility and ultra-low thermal conductivity due to the rotational motion of cations in the lattice even though it has only focused for optical energy conversion. However, optimization of electrical conductivity is still challenging which can lead to a landmark for thermoelectric application of this material. In this study, we optimize the growth parameters of $MASnI_3$ thin films by spin coating technique.

Thin films are fabricated by spin coating technique using a yellow precursor solution of $MASnI_3$. The yellow solution is prepared by MAI, SnI_2 precursors. During the fabrication process, we optimized growth parameters such as baking time and the presence of anti-solvent (Figure 1). $MASnI_3$ thin films have shown *p*-type semiconducting behavior. $MASnI_3$ thin films were thoroughly characterized using several state-of-the-art techniques including XRD and SEM. Temperature dependent Seebeck coefficient, electrical resistivity and thermal conductivity measurements were performed. $MASnI_3$ thin films baked at 100°C for 5 min with anti-solvent shows the best result with Seebeck coefficient about 65 μV/K and electrical conductivity of about 2 S/cm near room temperature.

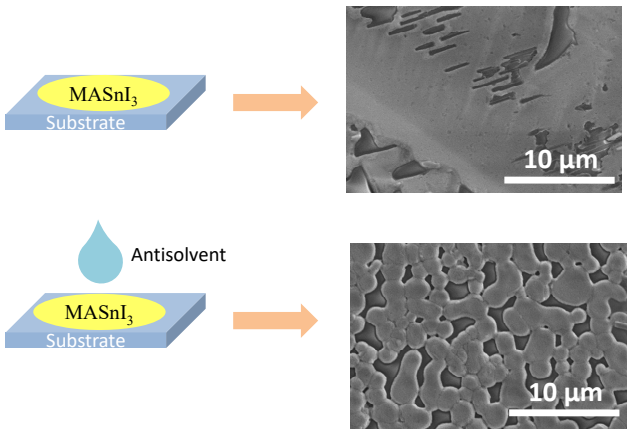

Figure 1: The effect of anti-solvent on the morphology of the $MASnI_3$ thin films.