The hole transporting behaviour of $Cu_2AgInS_4$and $Cu_2AgInSe_4$for carbon electrode based perovskite solar cell

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Electronic supplementary information (ESI)

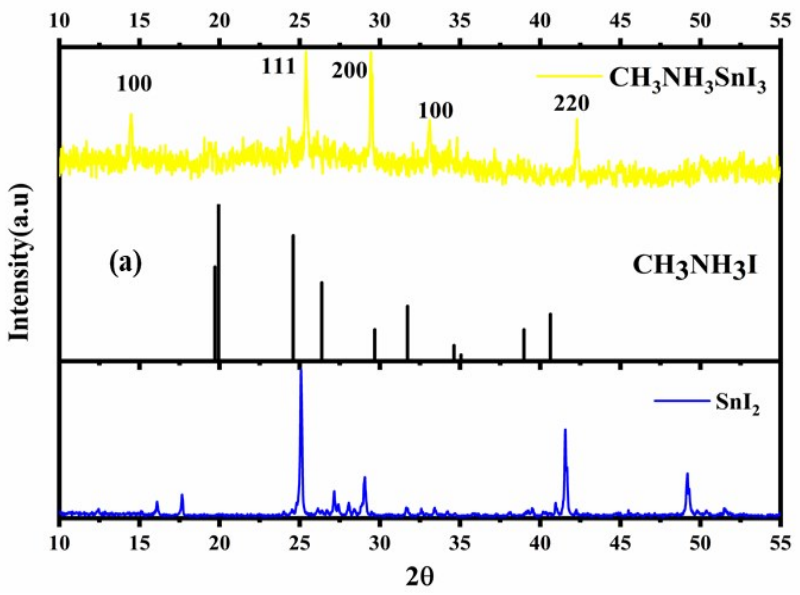

Fig.S1 XRD of $MASnI_3$ perovskite

XRD pattern of the perovskite is shown in Fig. S1. The diffraction peak at14.46°, 25.38°, 29.44°, 33.12°and42.74° correspond to (100), (111), (200), (012) and(220) planes of the tetragonal perovskitephase with a space group of P4mm. It clearly indicates that there is no other peaks of MAI, SnI_2 and SnO.

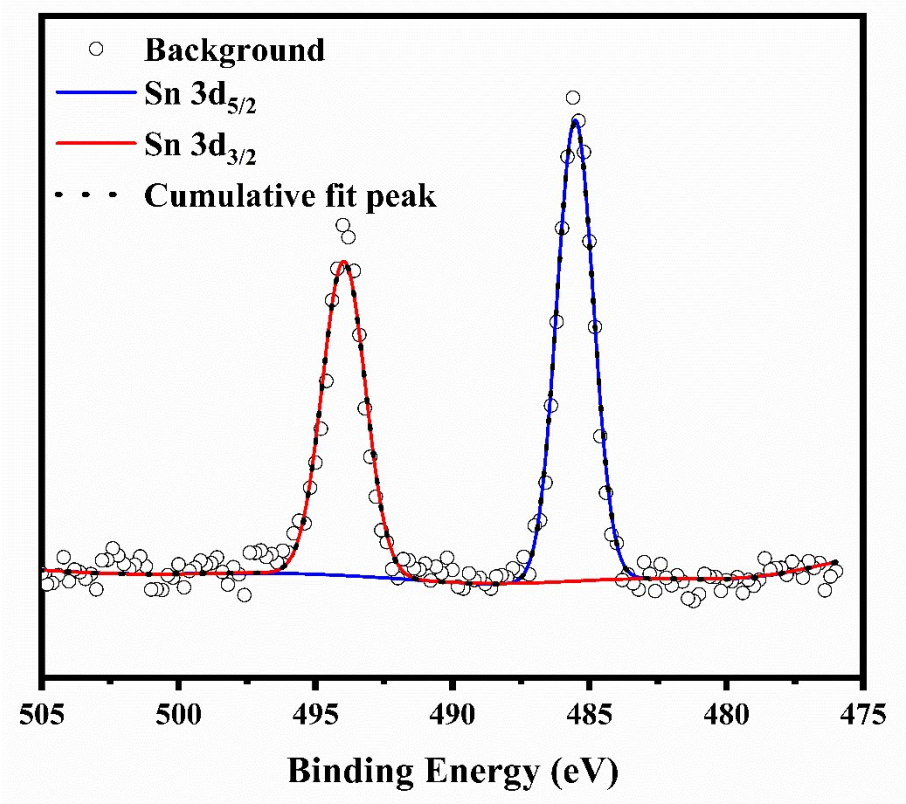

Fig.S2 HR-XPS of Sn element present in the $MASnI_3$ perovskite

The $Sn3d_{5/2}$ peak (Fig. S2) showed almostexclusively one type of Sn. The main band at 486 eV can beassigned to Sn^{2+}indicating pure Sn^{2+} (as Sn^{4+} would be expected at 488 eV and Sn^0 at 484.0 eV). These above results show the pure form of $MASnI_3$perovskite and free from other impurities[1-3].

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2. M. Weiss, J. Horn, C. Richter and D. Schlettwein, *physica status solidi (a)*, 2016, **213**, 975-981.
3. C. Mortan, T. Hellmann, O. Clemens, T. Mayer and W. Jaegermann, *physica status solidi (a)*, 2019, **216**.