INFLUENCE OF AMBIENT HUMIDITY ON CONDUCTIVITY OF $CH_3NH_3SnCl_3$ HYBRID FILMS

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Organic-inorganic $(C_nH_{2n+1}NH_3)_2MX_4$ hybrid perovskites (M=divalent metal, X=halide) are attracting much attention, due to their unique electronic properties and excellent film processability [1]. The Sn based $CH_3NH_3MX_3$ compounds are a subclass of that hybrid family, with cubic structure, where the organic component is included in the extended three-dimensional inorganic cage. Studies concerning the structural properties of these compounds [2] prove that methylammonium ions are orientationally disordered due to their polar character. On cooling the disorder is removed through one or more phase transitions, that usually determine large conductivity variations. However, the chemical instability is a major problem for accurate transport measurements on Sn hybrids. Furthermore, most of reported conductivity results refer to iodine-based hybrids, that are conductive, while Br- and Cl- compounds are semiconducting or insulating.

In this communication we study the influence of ambient humidity on the electrical properties of thermally ablated $CH_3NH_3SnCl_3$ films. In particular we show that conductivity increases by more than four orders of magnitude when relative humidity increases from 0 to 80%. Measurements performed in sequence give reproducible results, thus indicating that conductivity increase does not originate from irreversible reactions between hybrid and water vapour.

We investigate the mechanisms responsible for the conductivity increase by studying the DC and AC characteristics of two contact planar devices as a function of the relative humidity. The results of impedance spectroscopy measurements are interpreted by suitable equivalent circuits that allow us to study the dipendence of the different circuit components on relative humidity. On this base we discuss the device characteristics and suggest novel insights into humidity sensing properties of $CH_3NH_3SnCl_3$ films.

[1] D.B.Mitzi et al., *IBM J.Res.Dev*. **45**, 29-45 (2001)
[2] I. Borriello et al., *Phys. Rev.* B **77**, 235214, (2008)