Hydrophobic doping of hole transporting material to increase the long-time stability of perovskite solar cells

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Hybrid organic-inorganic perovskite materials have raised the interest in photovoltaic technology due to the ease of fabrication process and high solar to electricity power conversion efficiency (21%) in mesoscopic devices [1],[2]. In order to make them suitable for commercialization and out-door application, the issue of degradation of perovskite due to its moisture sensitivity and thus the stability of the device needs to be addressed. The use of hole transport material (HTM) is indispensable in order to fabricate efficient device. In the conventional device architecture, dopant and additives such as lithium salt, 4-tert butylpyridine (t-BP) and a cobalt-complex have to be used in order to enhance the conductivity and the hole mobility of the widely used Spiro-OMeTAD (2,2',7,7'-tetrakis(N,N-di-p-methoxyphenyl amine)-9,9-spirobifluorene) as well as in other small molecules based HTM. It was found that the use of these dopants and additives in the hole transporting layer reduces series resistance due to an enhancement in the hole injection, though, device long term stability and hysteresis remains a matter of concern, due to the highly hygroscopic lithium salts usage[3].

LiTFSI (Lithium bis(trifluoromethane)sulfonamide salt) is the most used additive since the $TFSI^-$ ion was most effective to raise the conductivity and for its sterically hindered structure and highly delocalized negative charge works as a weak coordination anion. But the lithium (Li^+) cation is very hygroscopic and dissolves the water sensitive perovskite. It is very susceptible to moisture and by doing so it contributes to the perovskite degradation [4]. To overcome these barriers we report a novel hydrophobic dopant that works effectively with Spiro-OMeTAD, enhances the life-time and the stability of the perovskite solar cells. The developed dopant was tested with other newly synthesized HTMs, and the devices kept in humid environment showed impressive results in terms of device stability.

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