# Ionic liquid polymer as an alternative to LiTFSI salt for over 20% efficiency and hysteresis-free perovskite solar cells

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Organic-inorganic hybrid perovskite solar cells (PSCs) have attracted worldwide attention due to an unprecedented increase in power conversion efficiency (PCE) which reached 22.7% within less than ten years. Most efficient systems usually involve hole transport materials such as spiro-OMeTAD doped using complex mixture made of LiTFSI salt, TBP and/or Cobalt coordination compounds. However, doping process relies on controlled ambient conditions such as oxygen and light exposure which leads to reproducibility and stability issues.

In this context, we herein report a metal-free formulation of spiro-OMeTAD based on an ionic liquid polymer efficient as hole transporter in n-i-p PSCs. Thus, the conductivity of spiro-OMeTAD was significantly improved by several orders of magnitude, up to 1.7 x $10^{-3}$ S.cm$^{-1}$, using poly(N-vinyl-3-alkylimidazolium bis(trifluoromethane) sulfonamide (PVBI-TFSI) as dopant. In the FTO/c-$TiO_2$/mp-$TiO_2$/$K^+$ doped $MA_{0.15}FA_{0.85}PbI_{2.55}Br_{0.45}$/HTM/Au PSC configuration, PVBI-TFSI-doped spiro-OMeTAD showed record power conversion efficiency as high as 20.4 %, versus 18.4 % for LiTFSI-doped spiro-OMeTAD, with considerably reduced hysteresis (Figure 1). Mechanistic investigations suggest that PVBI-TFSI acts as a source of protons promoting the spiro-OMeTAD oxidation and that the doping mechanism depends upon irradiance and tBP concentration. To the best of our knowledge, this is the best PSC performance reported so far with an alternative dopant in spiro-OMeTAD.

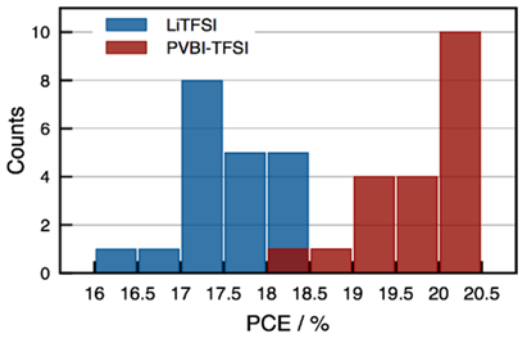


Figure 1: PCE histograms for 20 cells using LiTFSI (blue) or PVBI-TFSI (wine) as dopant

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