

## Electronic Supplementary Information

### Efficiency and Stability enhancement of Inverted Perovskite Solar Cells via the addition of metal nanoparticles in the Hole Transport Layer

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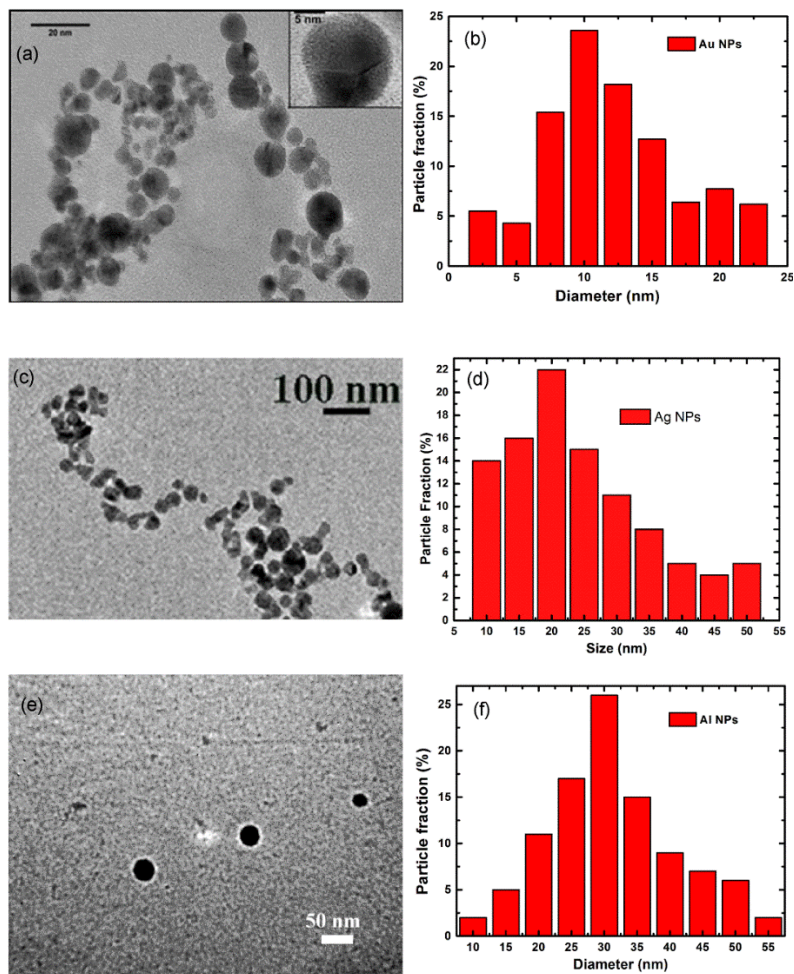
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## Tables

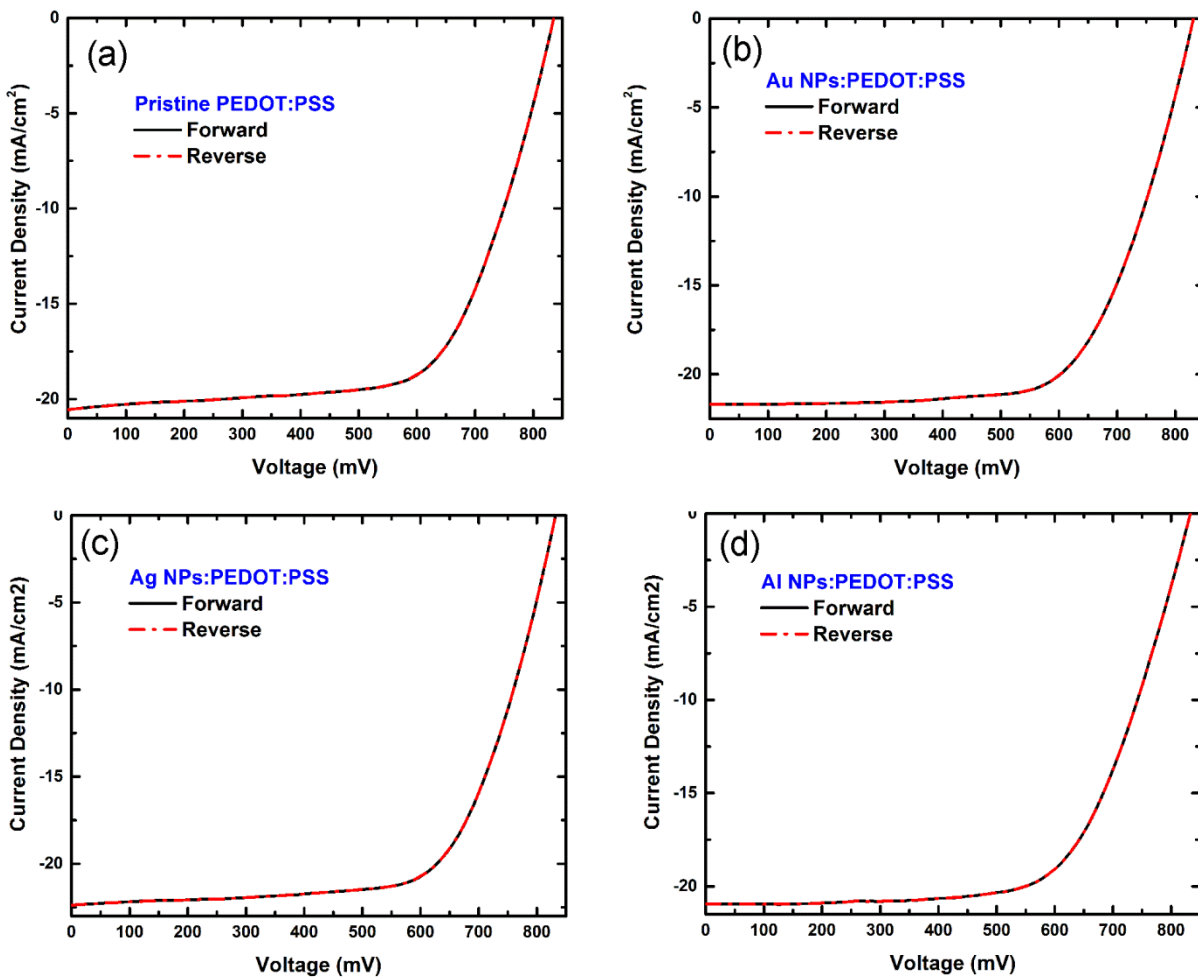
**Table S1:** Optimization of the different NPs concentration in the PEDOT:PSS HTL in terms of the Photovoltaic performance of PSCs.

NPs	$J_{sc}$ (mA/cm <sup>2</sup> )	$V_{oc}$ (mV)	FF (%)	Mean PCE (%)
No	20.55	838	65.83	11.33
1% Au	21.02	837	66.54	11.71
5% Au	21.69	837	67.03	12.18
10% Au	21.21	838	66.89	11.89
1% Ag	21.36	839	66.46	11.91
5% Ag	22.37	838	67.64	12.68
10% Ag	21.80	838	66.71	12.19
1% Al	20.68	839	66.02	11.45
5% Al	20.94	839	65.97	11.58
10% Al	19.28	839	59.39	9.61

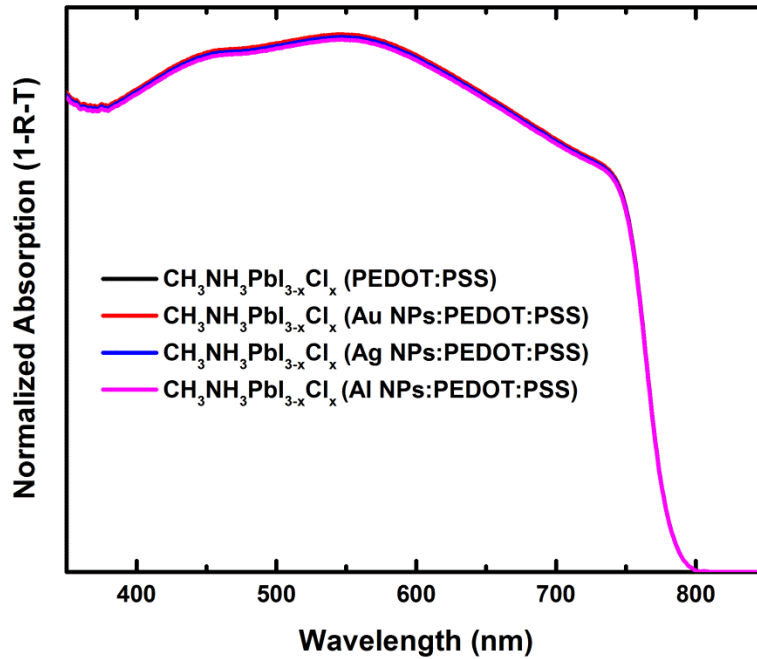
## Figures



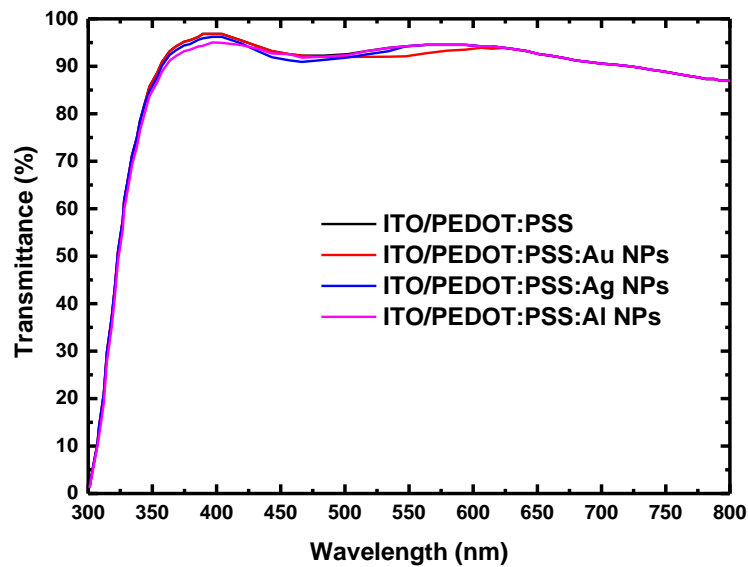
**Fig. S1** TEM images (left) and size distribution histograms (right) of gold nanoparticles (top), silver nanoparticles (middle) and aluminum nanoparticles (bottom) respectively.



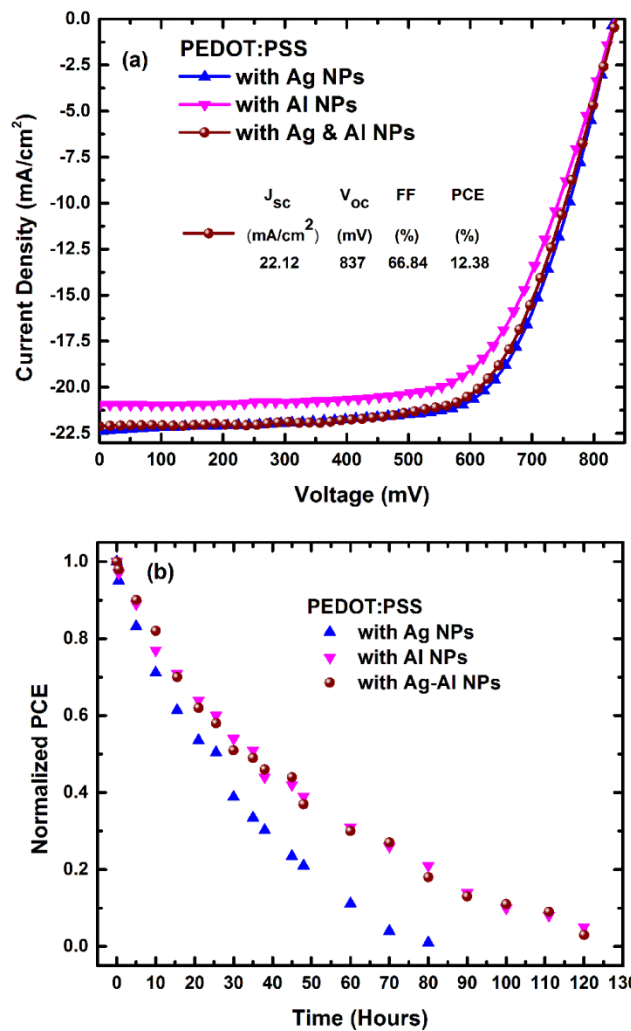
**Fig. S2** J-V curves of the (a) pristine, (b) Au, (c) Ag and (d) Al doped PEDOT:PSS based PSCs with both forward (black solid) and reverse (red dashed) scan of the applied voltage



**Fig. S3** Calculated absorption spectra (1-R-T) of the mixed halide perovskite deposited in the pristine and the different metal NPs doped PEDOT:PSS hole transport layers.



**Fig. S4** Comparison of transmittance between PEDOT:PSS and Au, Ag and Al doped PEDOT:PSS films on the glass/ITO substrate.



**Fig. S5** (a) The J-V curves of PSCs based on Al, Ag and Al-Ag doped PEDOT:PSS HTLs measured under AM 1.5G ( $100 \text{ mW cm}^{-2}$ ) illumination. (b) Evolution of normalized PCE of Al, Ag and Al-Ag doped PEDOT:PSS HTLs based PSCs under continuous solar illumination in ambient conditions ( $\sim 50\% \text{ RH}$ ).