

Supplementary Information

Room Temperature Nanoparticulate Interfacial Layers for Perovskite Solar Cells via solvothermal synthesis.

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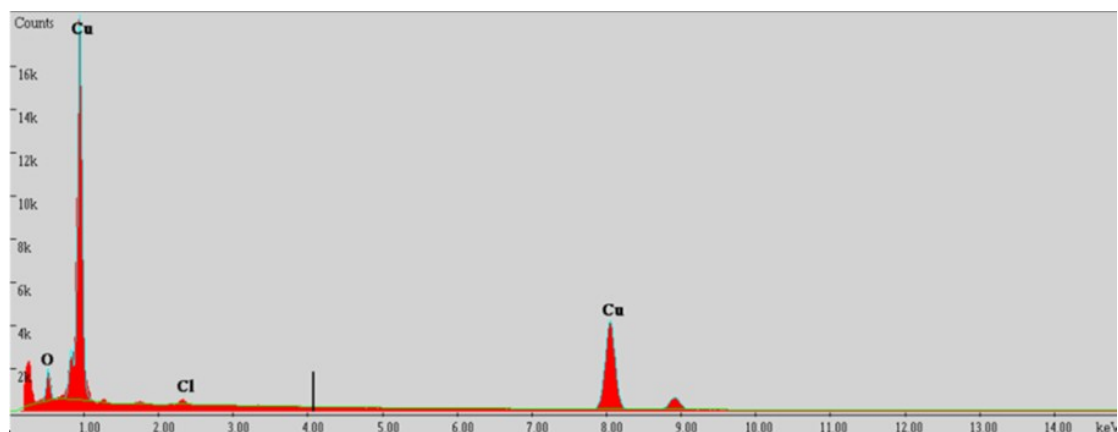


Fig. S1: EDS analysis of the as prepared CuO NPs obtained at 100 °C.

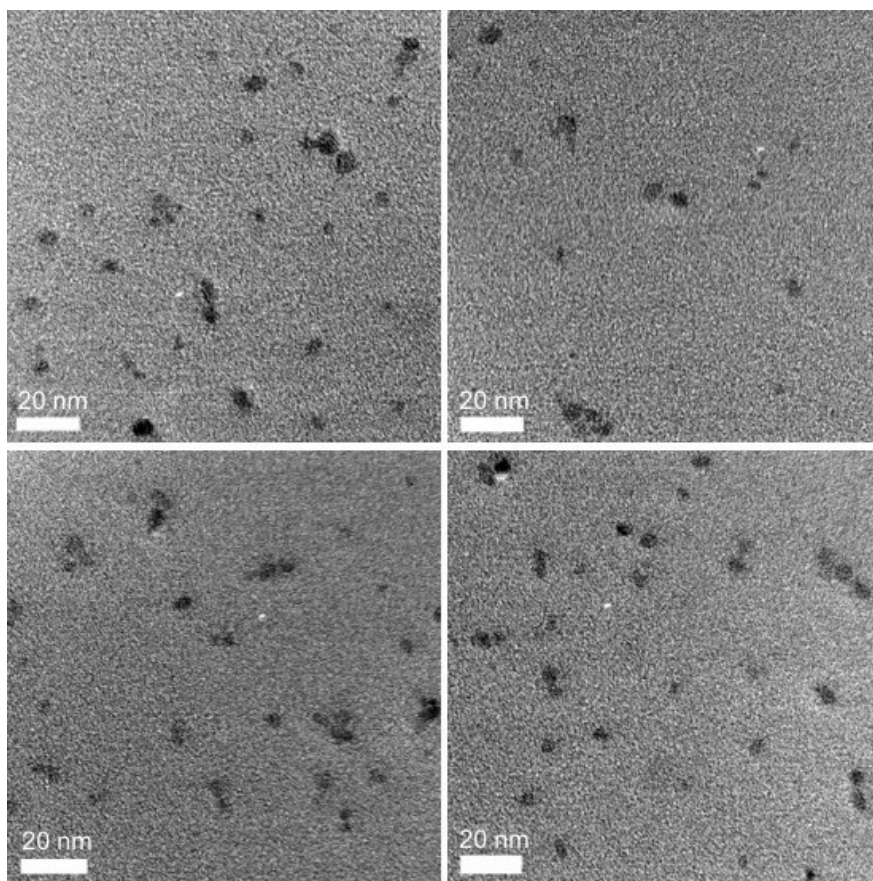


Fig S2: Representative TEM images for CuO NPs obtained at 100 °C decomposition temperature. The average diameter of the CuO NPs was estimated by counting more than 100 individual NPs in several TEM images. It should be stressed that the processing of the sample for TEM imaging was based on the requirements of the TEM instrumental conditions for the observation of nanoparticles (see Experimental section

within the article) and is not directly related to the processing conditions used on the preparation of CuO interfacial layers for perovskite solar cells.

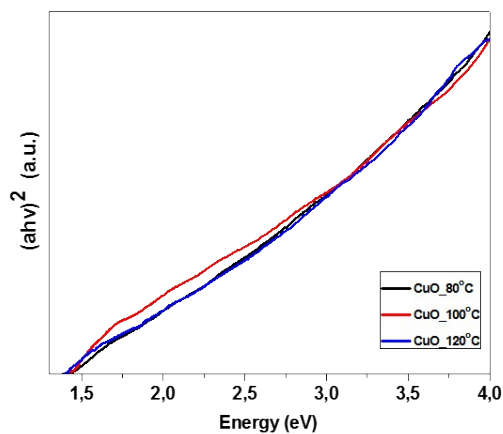


Fig. S3: The $(\alpha h\nu)^2$ vs. $h\nu$ plot for CuO nanoparticulate powders synthesized at 80 °C (black), at 100 °C (red) and at 120 °C (blue line).

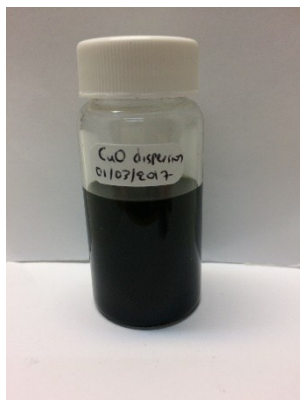


Fig. S4: Digital photograph of CuO dispersions in DMSO, 20 mg/ml. The dispersions were stable several months after fabrication. The concentrated dispersions were then diluted down to 0.5 mg/ml for the fabrication of CuO HTLs in the range of ~15 nm.

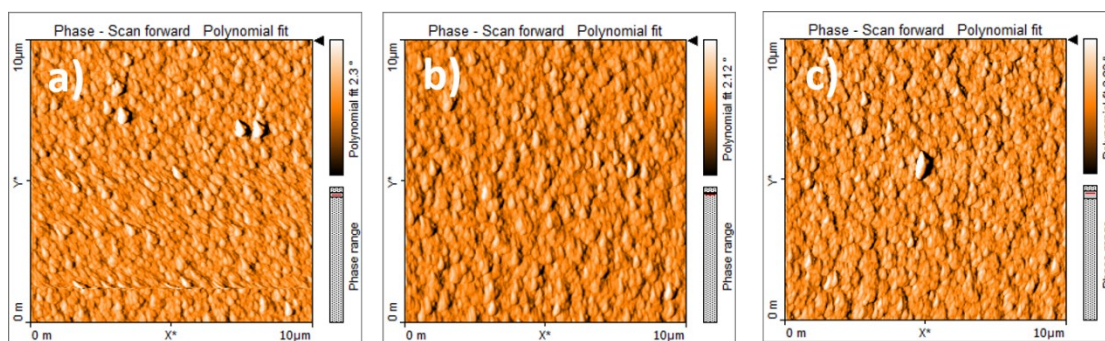


Fig. S5: AFM measurements for CuO-NPs thin films spin coated from DMSO dispersions at 0.5 mg/ml without any post deposition treatment. **a)** CuO NPs synthesized at 80 °C, **b)** CuO NPs synthesized at 100 °C **c)** CuO NPs synthesized at 120 °C.

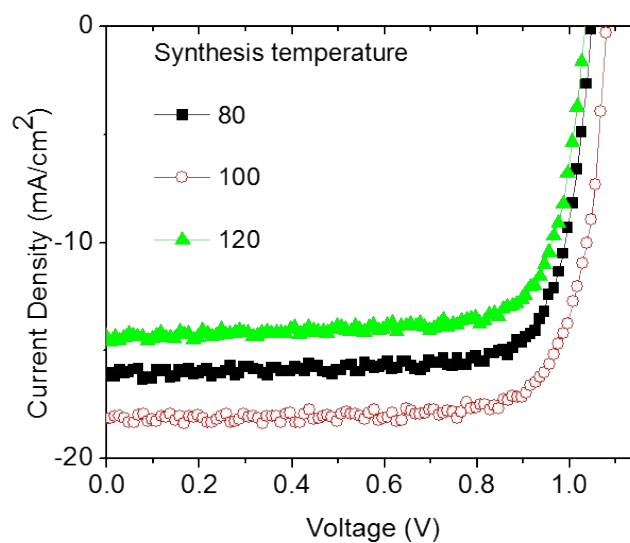


Figure S6: Current density–Voltage (J-V) characteristics, for p-i-n solar cells comprised of ITO/CuO-NPs/CH₃NH₃PbI₃/PC[70]BM/AZO/Al. CuO NPs synthesized at 80 °C with average size 5 nm (black filled squares), CuO NPs synthesized at 100 °C with average size 6 nm (red open circles) and CuO NPs synthesized at 120 °C with average size 9 nm (green filled triangles).

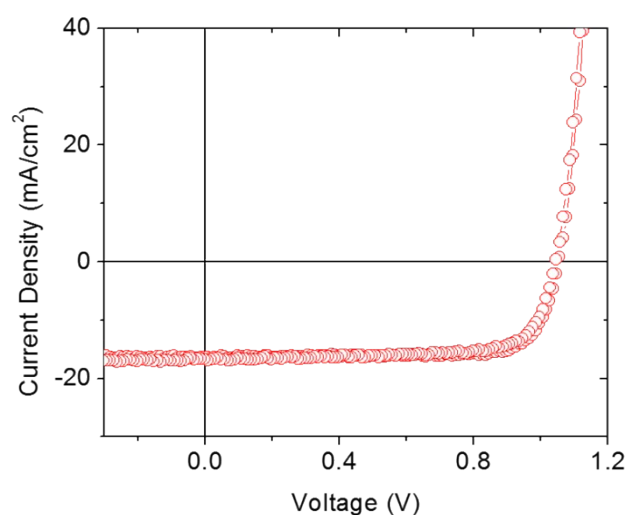


Fig. S7: Current density–Voltage (J-V) characteristics, for p-i-n solar cells comprised of ITO/CuO-NPs-100°C/CH₃NH₃PbI₃/PC[70]BM/AZO/Al in forward (short circuit -> open circuit) and reverse (open circuit -> short circuit).

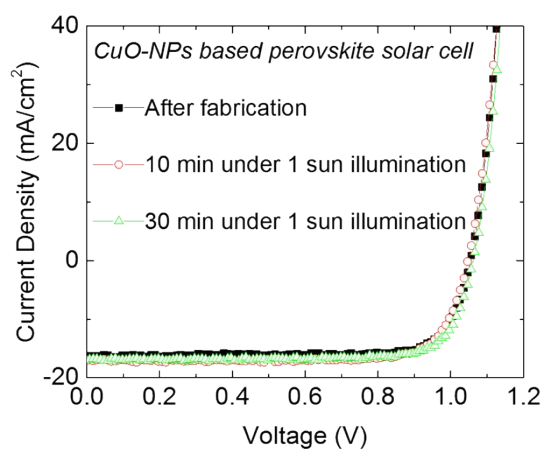


Fig. S8: Current density–Voltage (J-V) characteristics, for a representative CuO-based p-i-n solar cell, measured after fabrication (black filled squares), after 10 minutes under continuous 1 sun illumination (red open circles) and after 30 minutes of continuous 1 sun illumination (green open triangles).

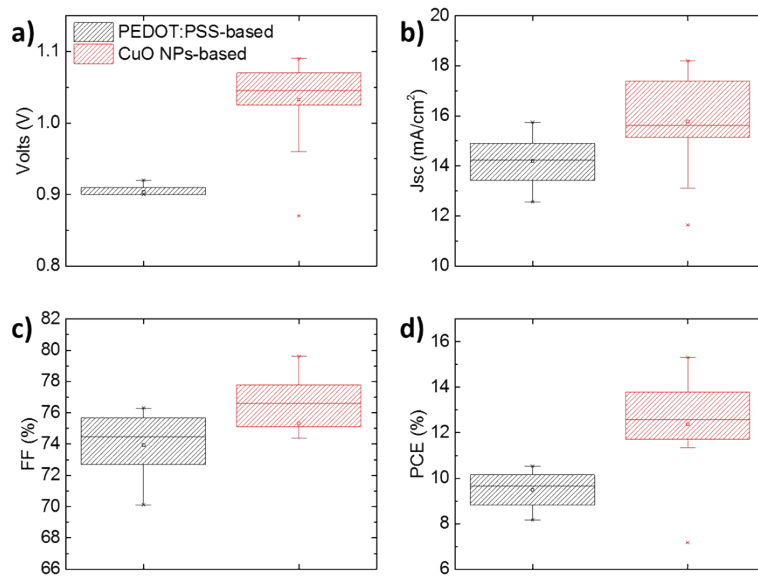


Fig. S9: Average photovoltaic parameters represented in box plots out of 16 devices of each series of p-i-n perovskite solar cells under study. PEDOT:PSS-based represented with black box plots and CuO-based with red box plots. **a)** Open circuit voltage (V_{oc}) **b)** current density (J_{sc}) **c)** fill factor (FF) and **d)** power conversion efficiency (PCE).