Supporting Information

A Microcontact Printed Nickel Passivated Copper Grid Electrode for Perovskite Photovoltaics

Anjana Wijesekara[1], *Marc Walker*[2], *Yisong Han*[2], *Ross Hatton* [1]*

[1] Department of Chemistry, University of Warwick, CV4 7AL, Coventry, United Kingdom.

[2] Department of Physics, University of Warwick, CV4 7AL, Coventry, United Kingdom.

*Corresponding Author. E-mail: Ross.Hatton@warwick.ac.uk

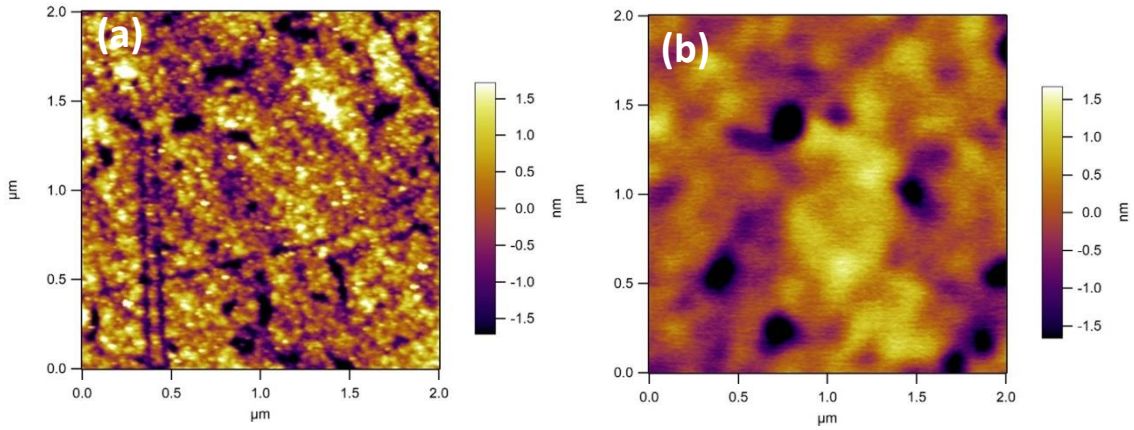

Figure S1: Topographic AFM image of the surface of a 5 nm thin Ni metal film before (root mean square roughness: 684 pm) (a) and after (root-mean square roughness: 525pm) (b) treatment with 0.007 mol dm^{-3} APS for 30 seconds. The resistance of the Ni film increased by 27% which is consistent with < 2 nm of Ni being removed. Under the same etch condition a 80 nm Cu film is completely removed.

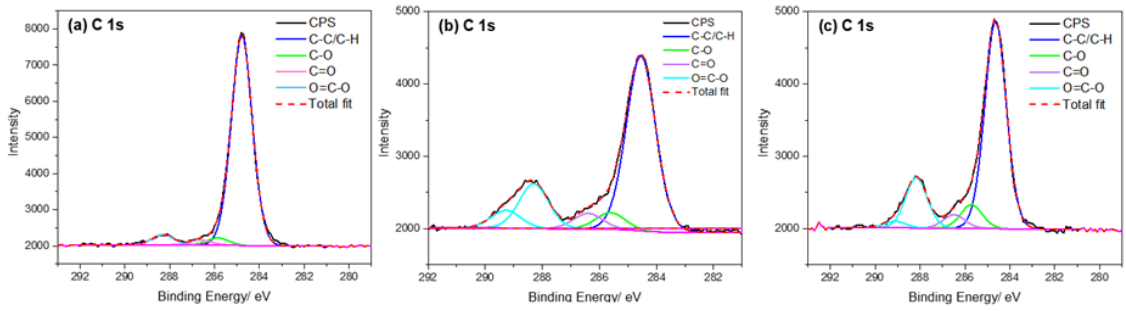

Figure S2: High resolution (HR) XPS spectra of the: (a) C 1*s* region for a film of Cu (80 nm)|Ni (2.5 nm)|Cu (4 nm), (b) UV-O_3 treated film of Cu (80 nm)|Ni (2.5 nm)|Cu (4 nm), (c) UV-O_3 and acetic acid treated film of Cu (80 nm)|Ni (2.5 nm)|Cu (4 nm).

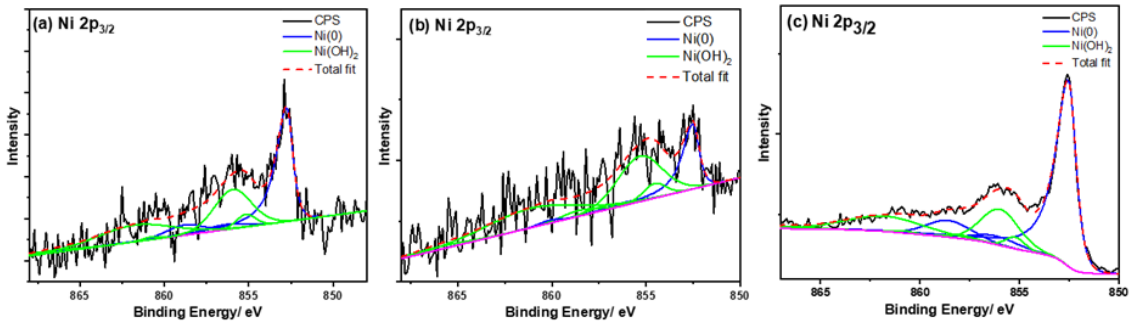

Figure S3: High resolution (HR) XPS spectra of the: (a) Ni $2p_{3/2}$ region for a film of Cu (80 nm)|Ni (2.5 nm)|Cu (4 nm), (b) UV-O_3 treated film of Cu (80 nm)|Ni (2.5 nm)|Cu (4 nm), (c) UV-O_3 and acetic acid treated film of Cu (80 nm)|Ni (2.5 nm)|Cu (4 nm)

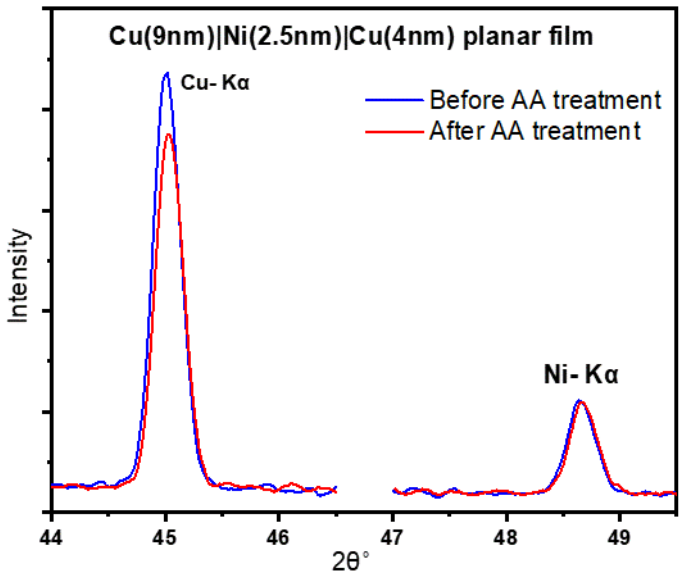

Figure S4: X-ray fluorescence analysis of a glass |Cu (9 nm)| Ni (2.5 nm)| Cu (4 nm) before (blue) and after (red) UV-O_3 and acetic acid treatment.

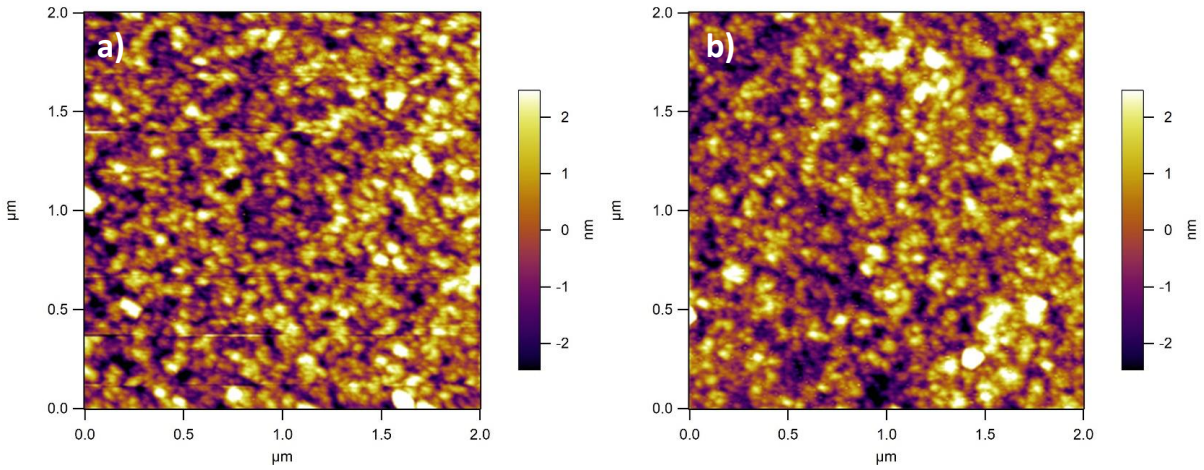

Figure S5: AFM image of the surface morphology of a) Glass |PH 1000 (PEDOT:PSS); b) Glass|PH 1000 (PEDOT:PSS) with 0.5 wt% of imidazole and 1 wt% (3-glycidyloxypropyl)trimethoxysilane.

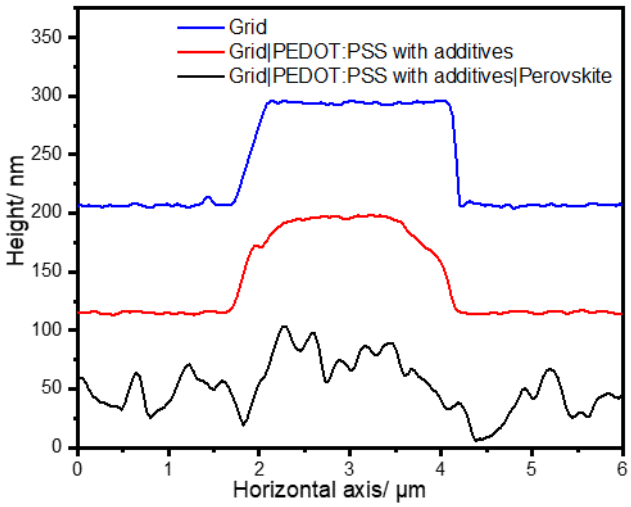

Figure S6: Representative AFM step cross-sections of grid lines: (Blue) before coating with PEDOT:PSS.; (Red) grid after coating with PEDOT:PSS (PH 1000 (PEDOT:PSS) with 0.5 wt% of imidazole and 1 wt% (3-glycidyloxypropyl)trimethoxysilane) deposition.; (Black) grid after coating PEDOT:PSS (PH1000 with 0.5 wt% of imidazole and 1 wt% (3-glycidyloxypropyl)trimethoxysilane.) and tin perovskite.

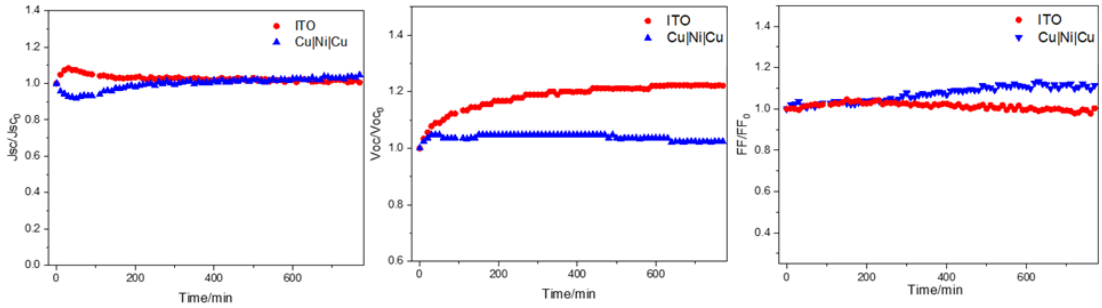

Figure S7: Representative evolution of the short-circuit current (J_{sc}), open-circuit voltage (V_{oc}) and fill-factor (FF) for devices tested under continuous 1 sun simulated solar illumination (xenon short arc lamp, AM1.5 G solar illumination at 100 mW cm^{-2}) with the devices under load at (or very close to) maximum power-point. Device testing was performed in a nitrogen-filled glove box (≤ 1 ppm O_2 and H_2O). Representative data sets shown are for devices with the structure: Transparent electrode | PEDOT:PSS (Al 4083)| Perovskite | C_{60}| BCP |Ag, where transparent electrode = ITO glass or Cu | Ni | Cu (grid) | PEDOT:PSS (PH 1000).