Supporting Information

Indium Tin Oxide-Free Inverted Organic Photovoltaics using Laser Induced Forward Transfer Silver Nanoparticle Embedded Metal Grids

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Tables

Table S 1: Photovoltaic parameters of the best performed ITO-based and ITO-free inverted OPV devices using 700nm thick PEDOT:PSS HIL-E100 formulation. As laser-printed (not embedded) Ag nps 9-line grid was used.

Device	V_{oc} [V]	J_{sc} [mA/cm^2]	*FF* [%]	*PCE* [%]
ITO/ZnO/PM6:Y6/MoO_3/Ag (global reference)	0.80	24.2	69.6	13.5
ITO/HIL-E100/ZnO/PM6:Y6/MoO_3/Ag	0.78	22.9	59.2	10.6
EMB-9/HIL-E100/ZnO/PM6:Y6/MoO_3/Ag	0.70	17.9	29.8	3.7

Table S 2: Photovoltaic parameters of the best performed ITO-free OPVs with laser-printed and embedded Ag nps 9-line grid, using three different PEDOT:PSS formulations, PH, PH500 and HIL-E100.

Device	V_{oc} [V]	J_{sc} [mA/cm^2]	*FF* [%]	*PCE* [%]
ITO/PH/ZnO/PM6:Y6/MoO_3/Ag	0.80	19.8	54.5	8.6
ITO/HIL-E100/ZnO/PM6:Y6/MoO_3/Ag	0.78	22.9	59.2	10.6
ITO/PH500/ZnO/PM6:Y6/MoO_3/Ag	0.76	26.8	59.6	12.1
EMB-9/PH/ZnO/PM6:Y6/MoO_3/Ag	0.76	7.5	34.3	1.9
EMB-9/HIL-E100/ZnO/PM6:Y6/MoO_3/Ag	0.76	16.8	37.1	4.7
EMB-9/PH500/ZnO/PM6:Y6/MoO_3/Ag	0.76	22.5	52.5	8.9

Figure Captions

Figure S 1. Investigation of ITO-free inverted OPV devices using the as printed not embedded Ag nps 9-line grid, a) cross-section profiles of the as laser-printed Ag nps grids on glass substrate, together with cross-section profiles after the coating of each functional layer. b) Illuminated *JV* characteristics of best performed ITO-based and ITO-free inverted OPVs using 700nm thick PEDOT:PSS HIL-E100 formulation.

Figure S 2. Atomic force microscopy images of Ag nps grid, a) before and b) after embedding process.

Figure S 3. Illuminated *JV* characteristics of the best performed ITO-free OPV devices, using embedded Ag nps 9-line (EMB-9) grid, with three different PEDOT:PSS formulations, PH, PH500 and HIL-E100.

Figure S 4: Profilometric analysis of the LIFT-printed and laser sintered Ag nps grid, a) as-printed, b) as-embedded and coated with PEDOT:PSS PH500 ~40nm layer followed by annealing at 140^{o}C – 20 minutes.

Figure S 5. Photocurrent mapping images of 9 mm^2 inverted OPV devices, ITO-based reference ITO-free OPV devices, with different number of laser-printed parallel line embedded Ag grids. The reference device in that case was ITO/PH500/ZnO/PM6:Y6/MoO_3/Ag.

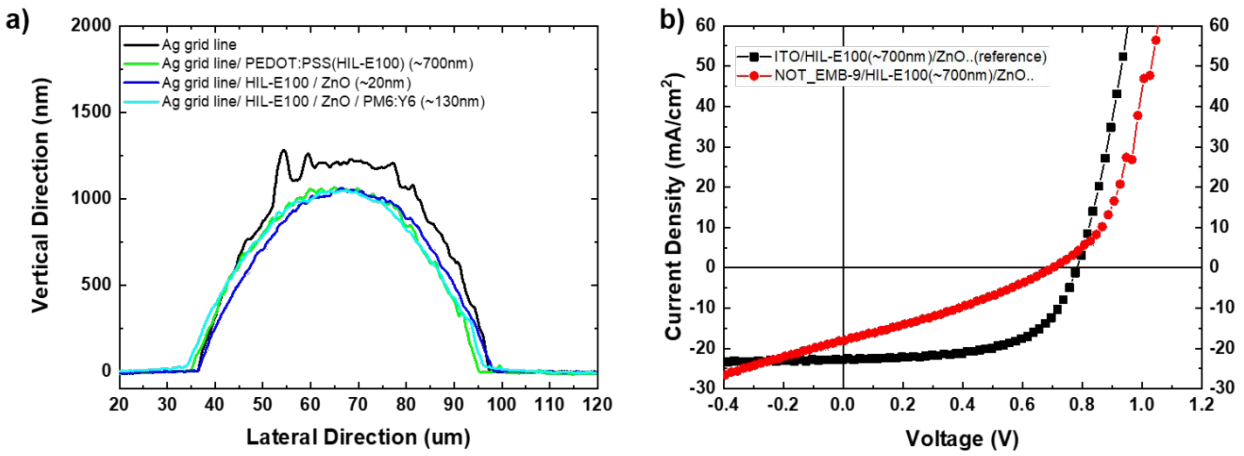


Figure S 1

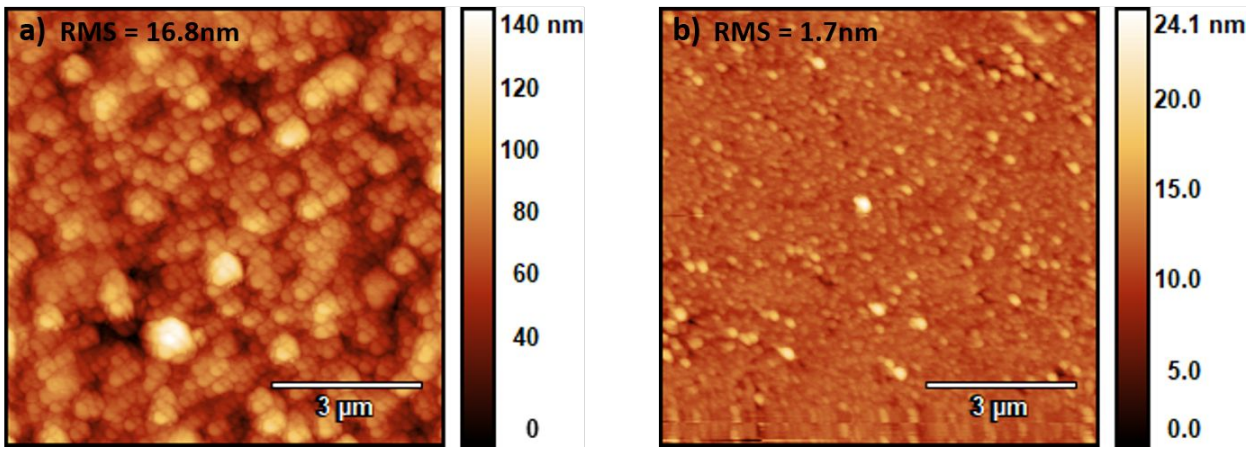


Figure S 2

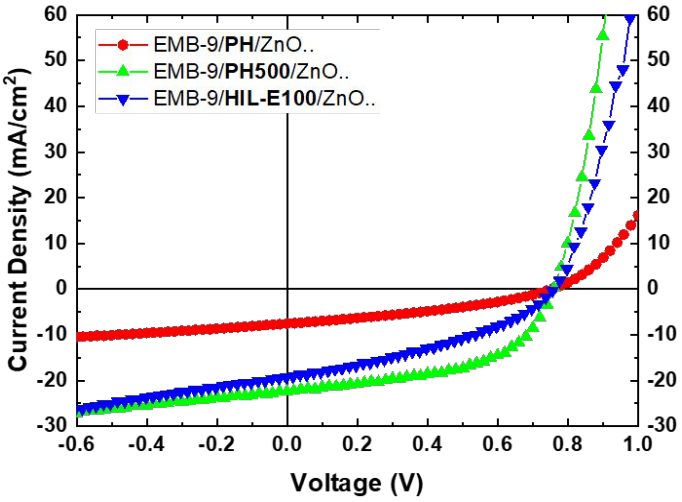
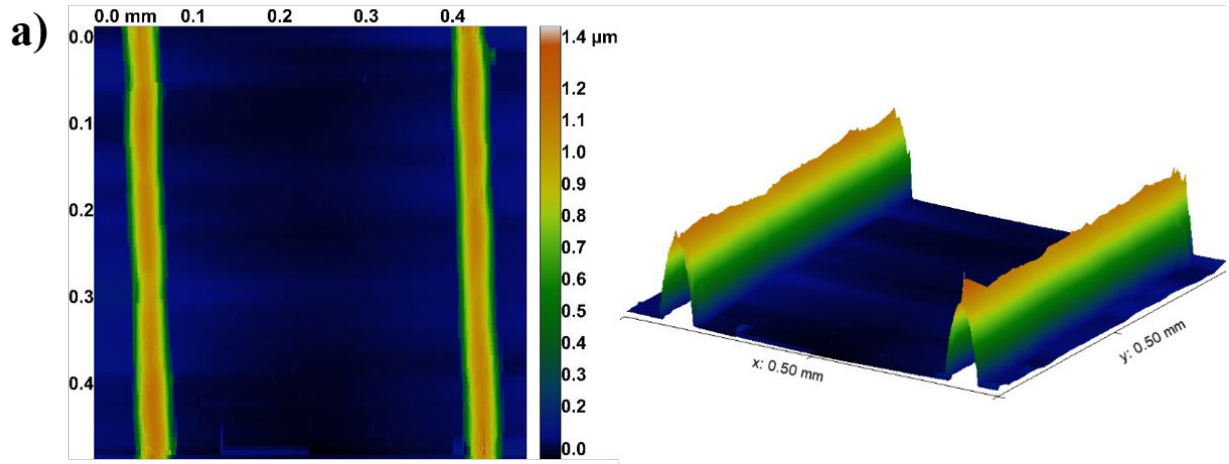
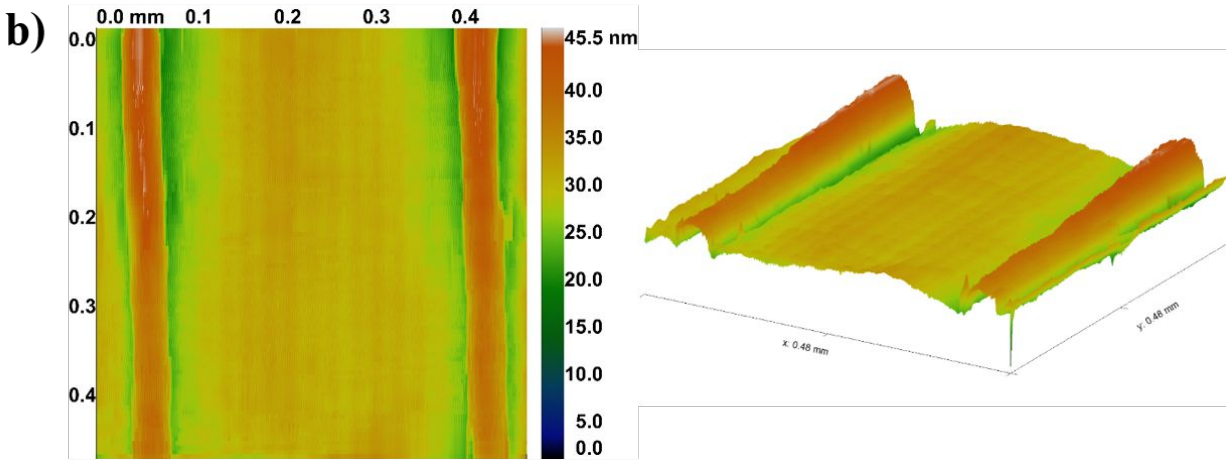

EMB-9/**PH**/ZnO..
EMB-9/**PH500**/ZnO..
EMB-9/**HIL-E100**/ZnO..
Current Density (mA/cm^2)
Voltage (V)
60
50
40
30
20
10
0
-10
-20
-30
-0.6
-0.4
-0.2
0.0
0.2
0.4
0.6
0.8
1.0

Figure S 3



LIFT-**printed** and laser-sintered Ag nps grid



LIFT-printed and laser-sintered and **EMBEDDED** Ag nps grid/**PH500 (~ 40nm) - annealed**

Figure S 4

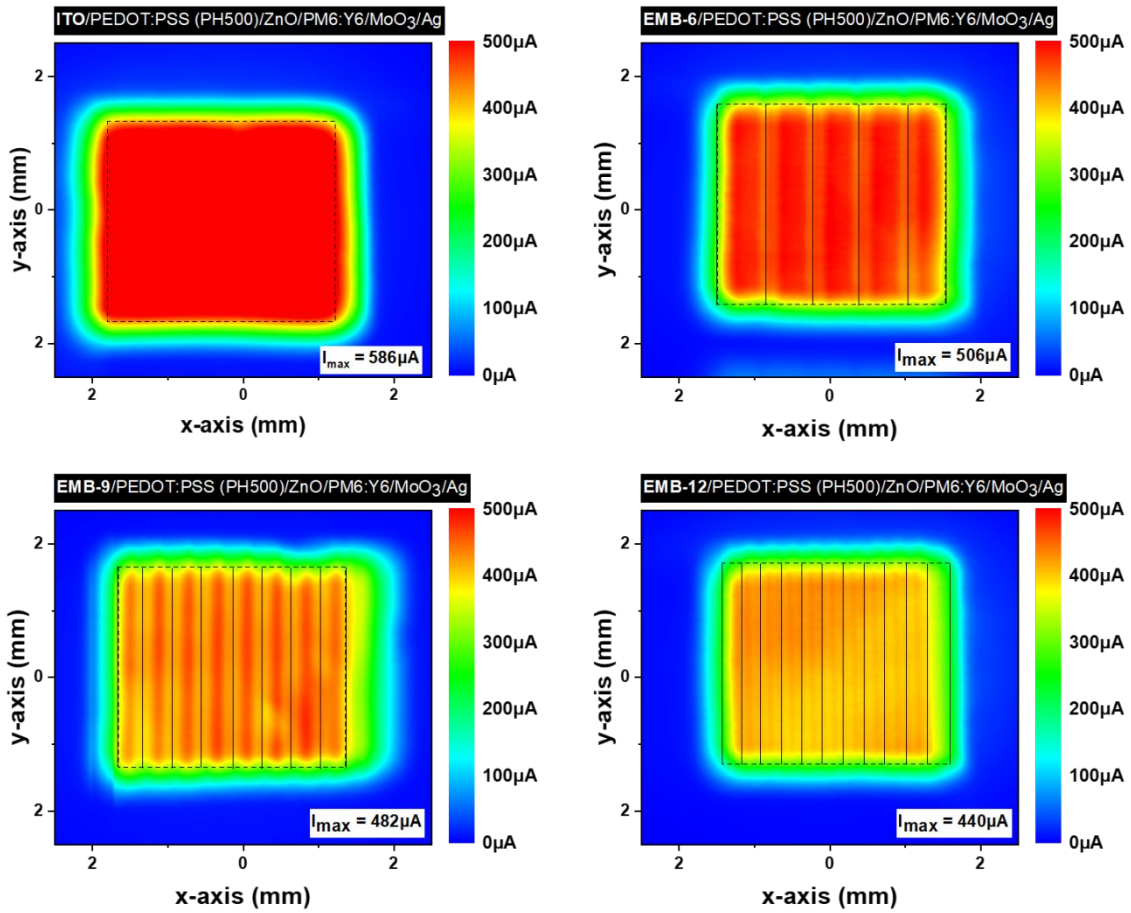

ITO/PEDOT:PSS (PH500)/ZnO/PM6:Y6/MoO3/Ag
EMB-6/PEDOT:PSS (PH500)/ZnO/PM6:Y6/MoO3/Ag
EMB-9/PEDOT:PSS (PH500)/ZnO/PM6:Y6/MoO3/Ag
EMB-12/PEDOT:PSS (PH500)/ZnO/PM6:Y6/MoO3/Ag
y-axis (mm)
x-axis (mm)
500μA
400μA
300μA
200μA
100μA
0μA
Imax = 586μA
Imax = 506μA
Imax = 482μA
Imax = 440μA

Figure S 5