Electronic Supplementary Information

Inkjet Printing of Oxide Thin Film Transistor Array at Small Spacing with Polymer-Doped Metal Nitrate Aqueous Ink

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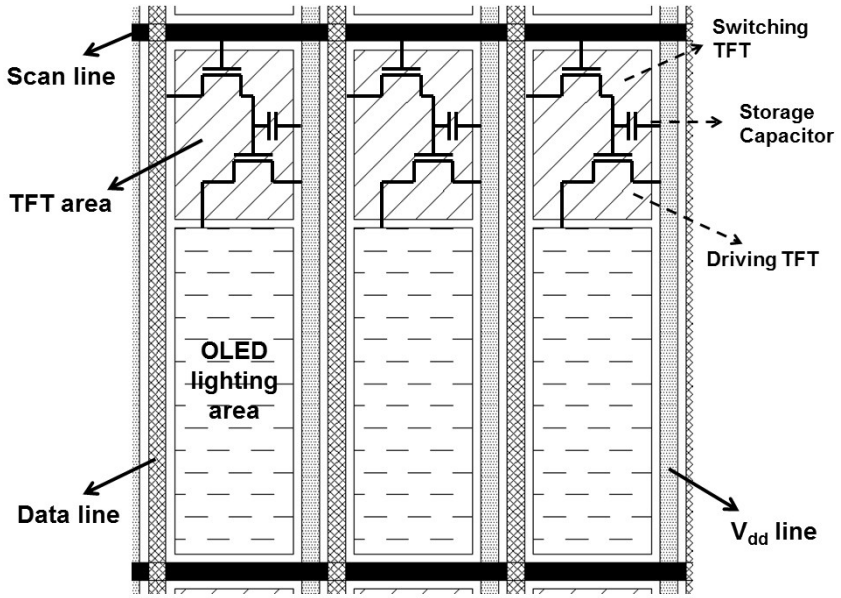

Fig. S1 A simplified layout of the pixel structure for 2T+1C (two transistors and one capacitor) driving 4K, 55 inch OLED display, where each sub-pixel is 103 μm × 309 μm. All of line width and interval are 10 μm and 5 μm, respectively. The OLED lighting area is 68 μm × 187 μm, leading to an aperture ratio of 40%. The area for the two TFTs is only 68 μm × 187 μm.

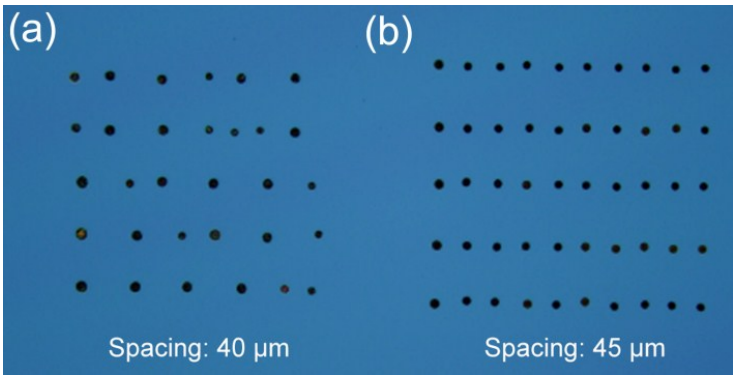

Fig. S2. An example of inkjet printed indium oxide dot arrays on a HMDS-treated SiO_2 substrate with drop spacing of 40 μm (a) and 45 μm (b), at 0.2 M indium nitrate aqueous solution and nozzle of 10 pL. When the drop spacing was 40 μm, some neighboring dots joined together (Fig. S2a). The phenomenon was not observed at the 45 μm spacing (Fig. S2b). In this case, the minimum spacing of printed array was determined to be 45 μm.

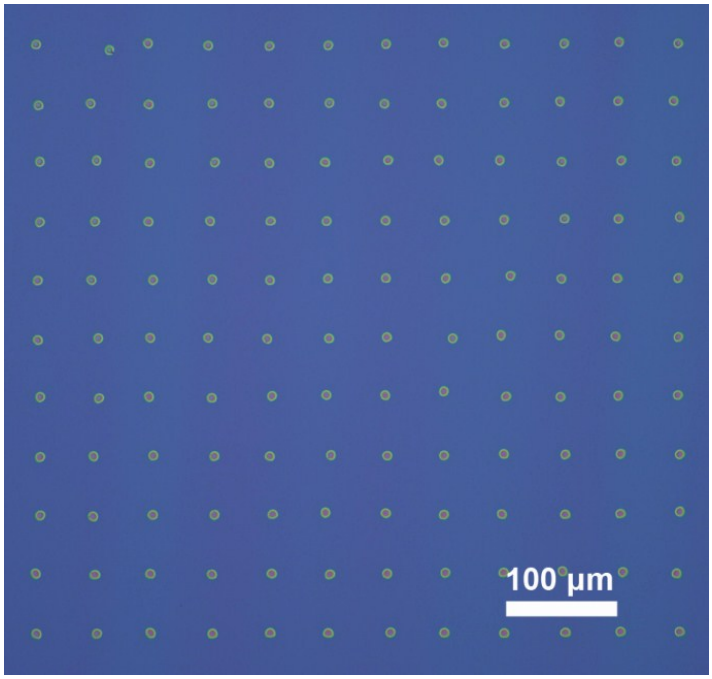

Fig. S3 An inkjet printed indium oxide dot array on a HMDS-treated SiO_2 substrate with nozzle of 10 pL and pristine indium nitrate aqueous solution. One can see there are some dots being not in line, because some inhomogeneous factors such as defect and stain on substrate would promote droplets deviating from the original position during the shrinking. The deviation is comparable to the dried dot size, which can cause the later patterning of source and drain electrodes to misalign to the oxide channels.

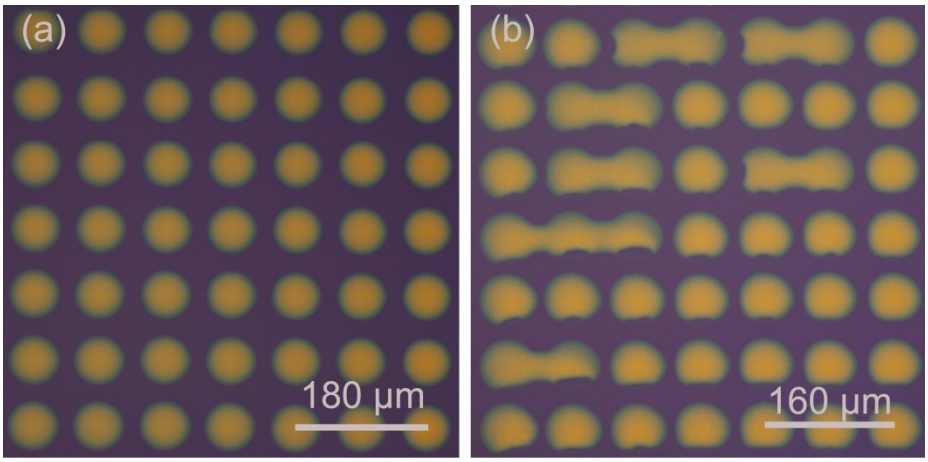

Fig. S4 Inkjet printed indium oxide dot arrays on UVO-treated SiO_2 substrates with drop spacing of 90 μm (a) and 80 μm (b), with PVP doped ink of 0.2 M indium nitrate aqueous solution and nozzle of 10 pL. It shows that the minimum spacing of printed array is about 90 μm and the dot size is around 70 μm.

Table S1. Viscosities of glycerol and PVP aqueous solutions at different concentrations.

Glycerol (wt%)	Viscosity (mPa·s)	PVP K30 (mg/mL)	Viscosity (mPa·s)	PVP K85-95 (mg/mL)	Viscosity (mPa·s)
0	1	0.05	1	0.05	1
5	1.1	0.1	1	0.1	1
10	1.2	0.2	1	0.2	1
20	1.5	0.5	1	0.5	1.1
30	2.1	5	1.1	5	1.6
50	5.8	50	2.3	50	7.2
100	905.5	200	14.7	200	833.5

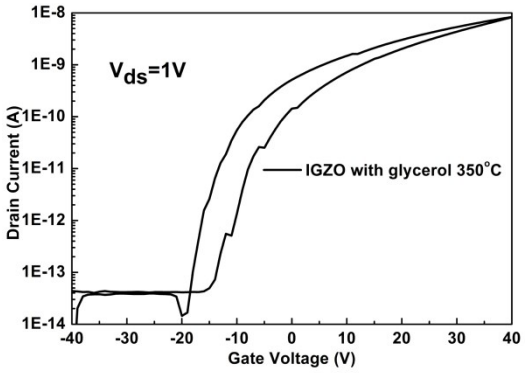

Fig. S5 Typical transfer curves of inkjet-printed IGZO-TFTs on HMDS-treated substrate annealed at 350 ^{o}C, by using ink of 0.02 M metal nitrate aqueous solution mixed with 30 wt% glycerol. The drain current was normalized by W/L=1. Its mobility is about 0.027 $cm^2 V^{-1} s^{-1}$.

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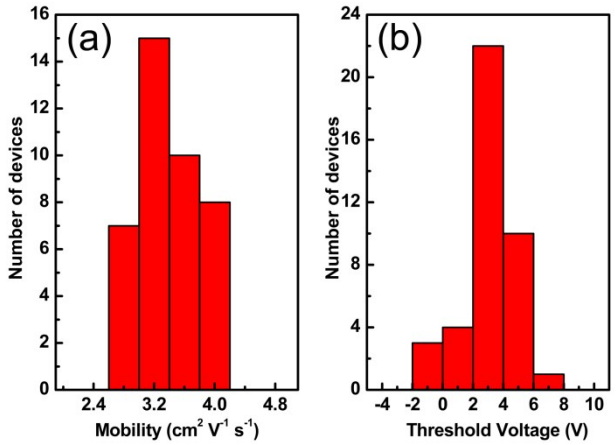

Fig. S6 Histograms of the (a) mobility and (b) threshold voltage for printed IGZO-TFTs which were printed with PVP doped ink on HMDS-treated substrate and annealed at 300 ^{o}C.

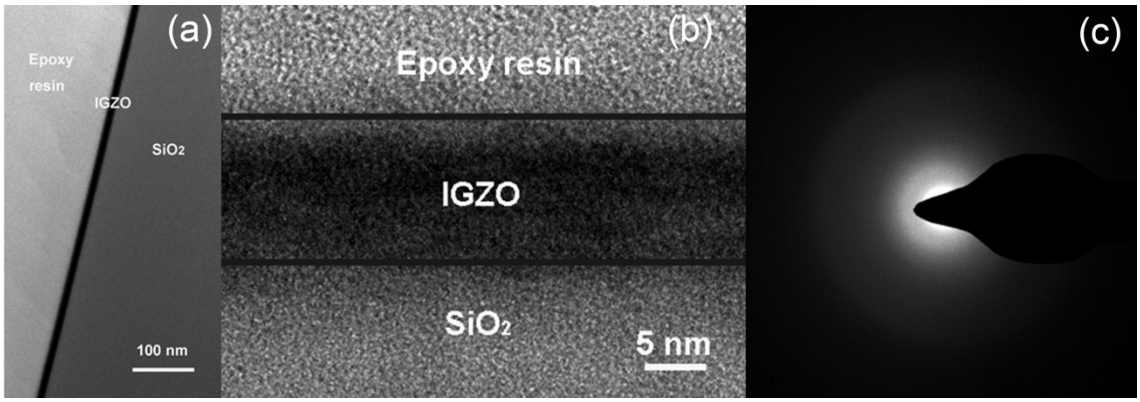

Fig. S7 TEM images of cross section (a and b) and corresponding FFT patterns (c) of IGZO film which was printed with PVP doped ink on HMDS-treated substrate and annealed at 350 ^{o}C in air for 2 hours.

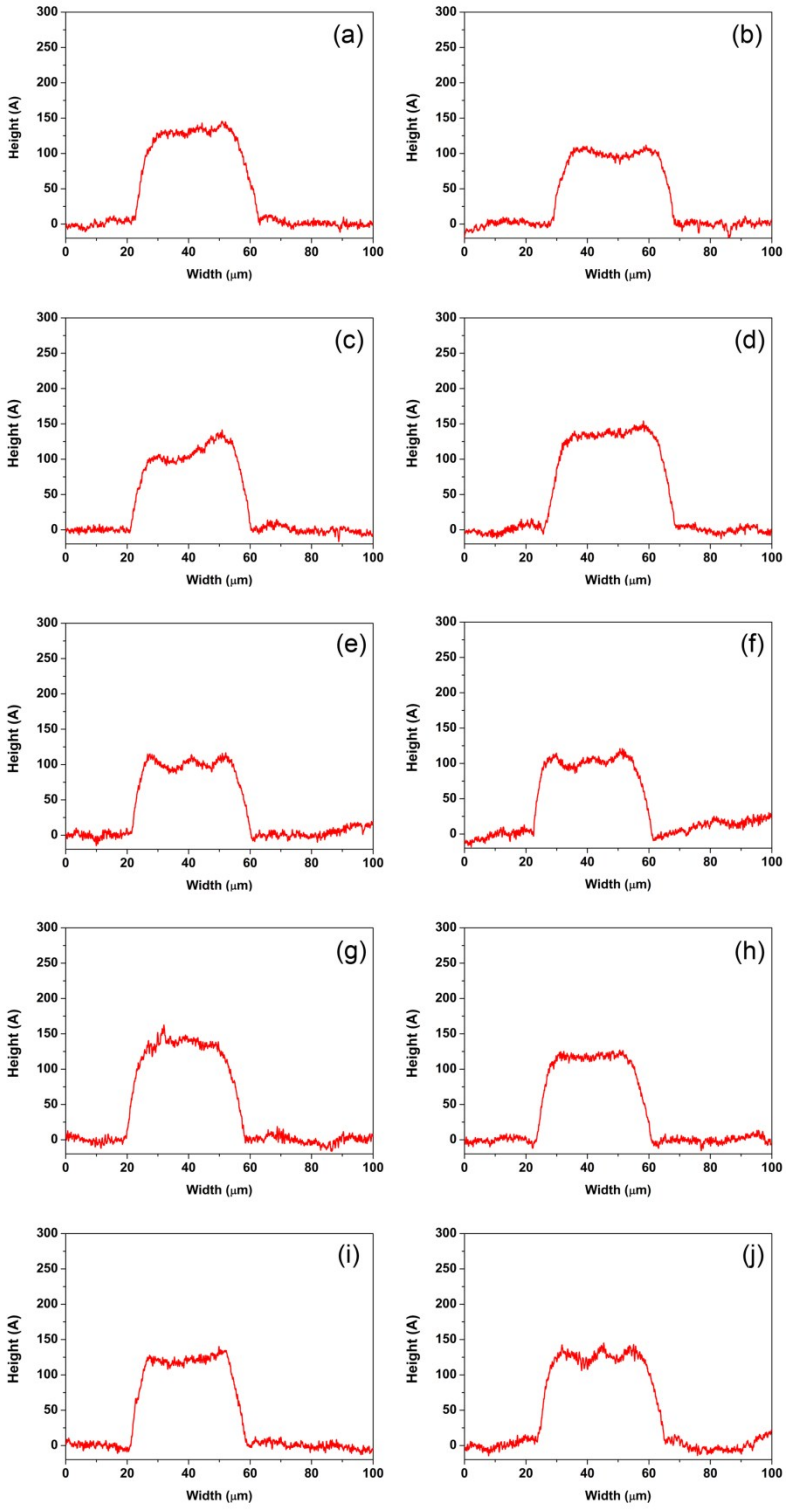

Fig. S8 Randomly selected topographical profiles of printed dots in an IGZO array on HMDS-treated substrate (PVP-doped ink and annealed at 350 ^{o}C).

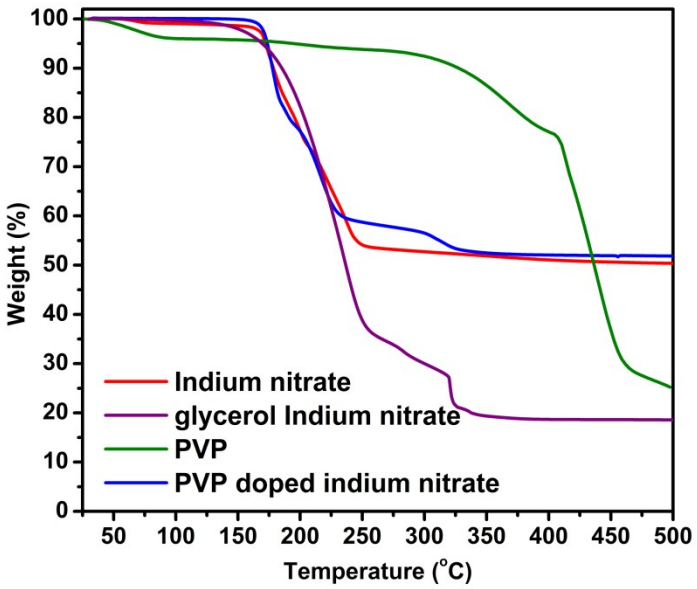

Fig. S9 The TGA measured in air of the powders dried off at 40 °C from pristine aqueous solutions of $In(NO_3)_3$, K30 PVP, 0.02 M $In(NO_3)_3$ solution mixed with 30wt% glycerol, and 0.02 M $In(NO_3)_3$ mixed with 0.1 mg/mL K30 PVP.