Supporting Information

Performance Improvement for Printed Indium Gallium Zinc Oxide Thin-film Transistors with Preheating Process

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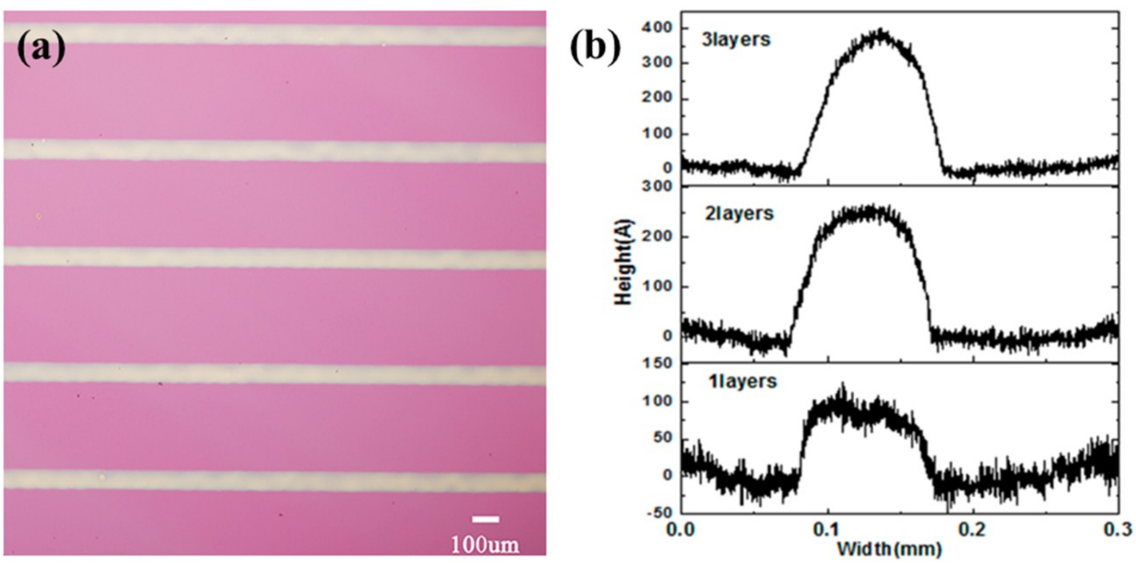

Figure S1. (a) Optical morphology of the ink-jet printed IGZO lines on SiO_2/Si substrate and (b) 2-D profiles of the printed lines with 1-3 times printing repeatedly, where the IGZO lines were annealed at 300°C in furnace for 2h after a hotplate preheating at 275°C.

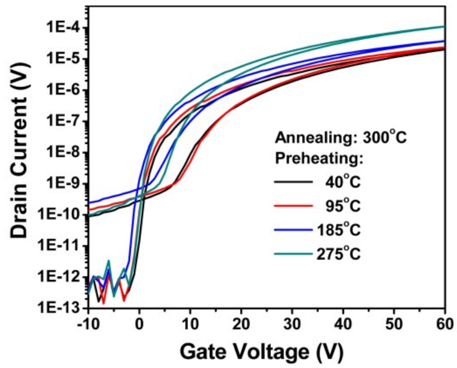

Figure S2. TFT characteristics of the spin-coated IGZO thin film poste-annealed at 300°C with different hotplate preheating temperature of 40, 95, 185 and 275°C.

Table S1. Electrical parameters of the spin-coated IGZO-TFTs (shown in Fig. 2S) annealed at 300°C with Different Preheated Temperatures.

preheating temperature (°C)	field effect mobility, μ ($cm^2V^{-1}s^{-1}$)	threshold voltage, V_{th} (V)	sub-threshold swing, *SS* ($V \cdot dec^{-1}$)	current on/off ratio, I_{on}/I_{off}
40	1.44	10	0.80	$\sim 10^8$
95	1.57	10	0.83	$\sim 10^8$
185	2.37	8	0.76	$\sim 10^8$
275	7.90	10	0.73	$>10^8$

Table S2. Molar ratio of In: Ga: Zn: N that is detected from XPS spectra of the spin-coated IGZO films annealed at 300^{o}C with Different Preheating Temperatures.

preheating temperature (^{o}C)	In: Ga: Zn: N (molar ratio)
40	3: 0.68: 2.14: 1.17
95	3: 0.65: 2.23: 1.09
185	3: 0.60: 2.24: 1.12
275	3: 0.55: 2.16: 1.17

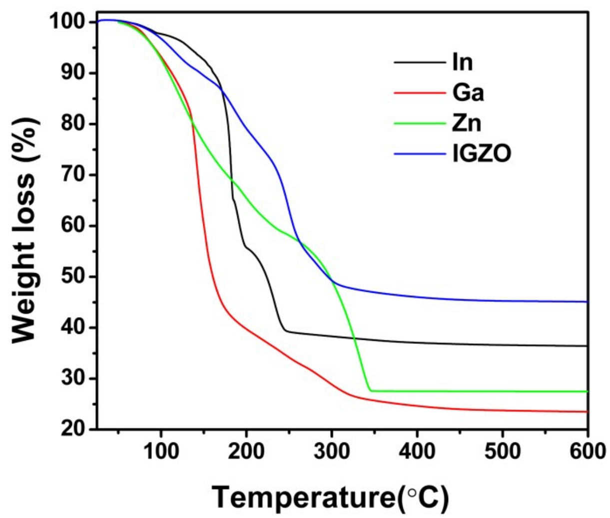

Figure S3. The TGA measured in air of the powders dried off at 40°C from solutions of $In(NO_3)_3$, $Ga(NO_3)_3$, $Zn(NO_3)_2$ and IGZO precursor solution.

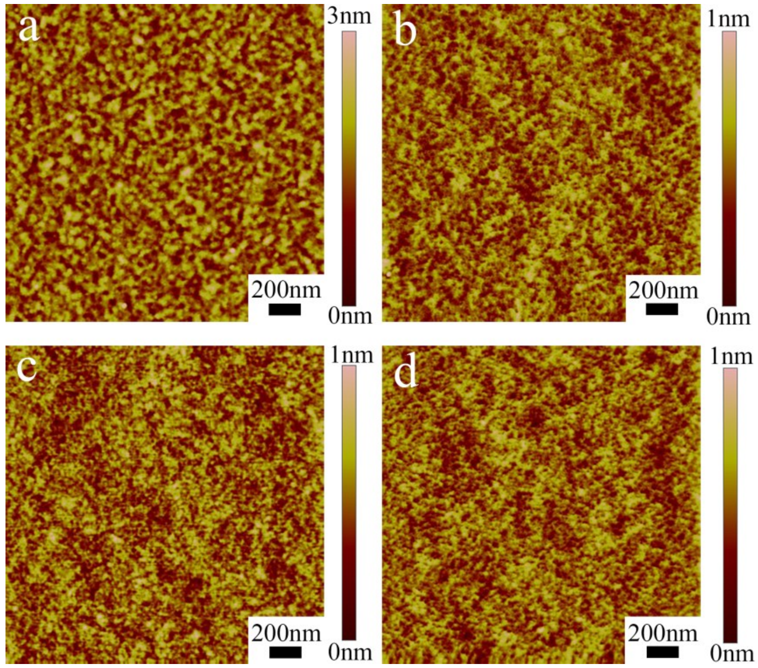

Figure S4. AFM images of surface morphology of the spin-coated films annealed at 300^{o}C in furnace for 2h with variable hotplate preheating temperatures: (a) 40ºC (RMS=0.43 nm), (b) 95ºC (RMS=0.13 nm), (c) 185ºC (RMS=0.14 nm), (d) 275ºC (RMS=0.13 nm).