SUPPORTING INFORMATION

Pressure-assisted Printing with Crack-free Metal Electrodes using an Anti-adhesive Rigiflex Stamp

Min Jung Lee, Joohee Kim, Ji Soo Lee and Youn Sang Kim *

Experimental

Materials: trimethylolpropane propoxylate triacrylate (TPT), 2-hydroxy-2-methylpropiophenone (HOMPP) were purchased from Aldrich. Potassium iodide (KI) and iodine (I_2) were obtained from Duksan. Poly(methyl methacrylate) (PMMA, MW=100,000) was used as received from Polysciences Inc.

Stamp: First, a PDMS mold obtained from a master consisted of Si or SiO_2 wafer (80 ℃/2 h thermal curing), and we used this PDMS mold to fabricate a TPT stamp on the PET flexible substrate (SKC) under UV light (λ=365 nm, 135 mW/cm^2) for 1 h. The stamp was made by mixing trimethylolpropane propoxylate triacrylate (TPT) and the photoinitiator, 2-hydroxy-2-methylpropiophenone (HOMPP), at a ratio 95:5 (v/v). Then, the Au layer (100 nm, 0.2 nm/s) evaporated onto the TPT stamp. Finally, the Au deposited TPT stamp was brought onto the PET substrate by applying pressure (0.2 MPa) and thermal treatment (70℃) for 5 min using a press machine. This machine consists of two controllers: temperature controllers on the top of the stamp and bottom side of the substrate and a pressure controller, as shown in Figure S3. The machine simultaneously applies pressure and temperature.

Organic Thin Film Transistor: First, Al layer was deposited on the PET flexible substrate as a gate electrode (100 nm, 0.2 nm/s). Second, 10 wt% poly(methyl methacrylate) (PMMA) (MW=100,000) in toluene was spin-coated on the Al-deposited PET film at 3,500 rpm for 30 s and prior to spin coating, substrate was exposed to UVO for 30 min to uniformly coating on the overall surface. After coating, annealing process was added at 100 ℃ for 1 h to remove solvent. Third, Au source/drain electrodes

were transferred from the Au deposited TPT stamp fabricated PDMS mold to the substrate using press machine as a mentioned in Fig. S3. At this time, channel length (L) and width (W) were about 25 um and 1,000 um, respectively. Finally, pentacene was deposited on the substrate (50 nm. 0.05 nm/s).

1. Modulus and hardness of the TPT and the PDMS stamp.

	TPT	**PDMS**
Young's modulus	1.6780 GPa (± 0.117 GPa)	0.0024-0.0045 GPa [1]
Hardness	0.0230 GPa (± 0.011 GPa)	(not measured)

Table S1. Modulus and hardness of the TPT and the PDMS stamp

Modulus and hardness of the TPT stamp were measured by nanoindentation (nanoindenter XP, MTS). The specimens were measured at 50~150 nm of the displacement into surface.

2. The differences between PDMS and TPT stamp

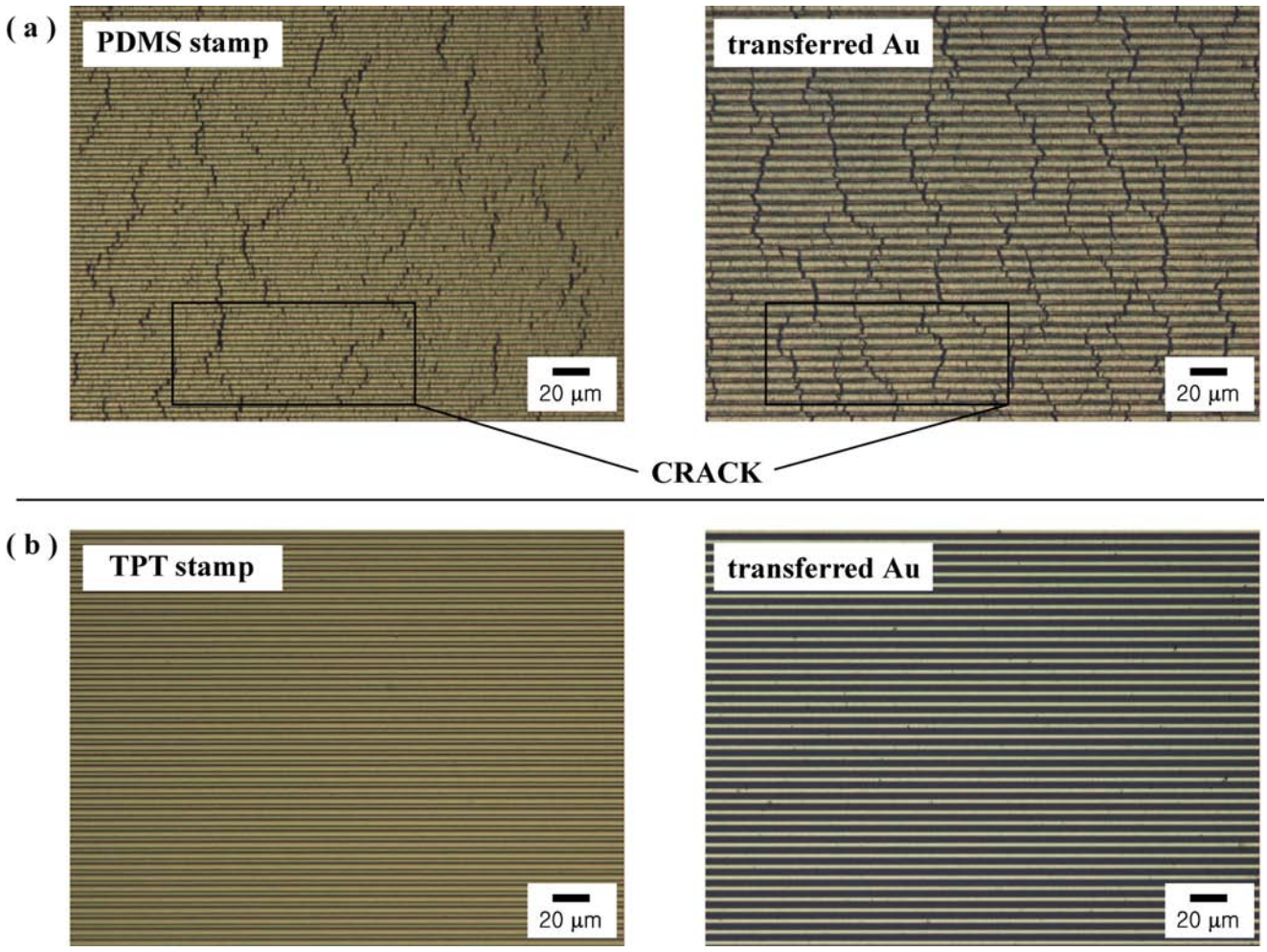

Figure S1. Optical microscopy of intrinsic Au deposited (a) PDMS and (b) TPT stamp and transferred Au line patterns from (a) and (b), respectively.

In particular, in case of PDMS stamp, the severe cracks and deformations are seen not only the transferred Au lines but the Au deposited PDMS stamp owing to its elastomeric property. (In case of fig.(a), the pressure was 0.05 MPa-PDMS stamp was not suitable to pressure-assisted process) However, in case of the TPT material we used here as the rigiflex stamp, the cracks and deformations are not seen compared with PDMS stamp. (In case of fig.(b), the pressure was 0.2 MPa-TPT stamp was suitable to pressure-assisted process)

3. Au line patterns with bi-layers

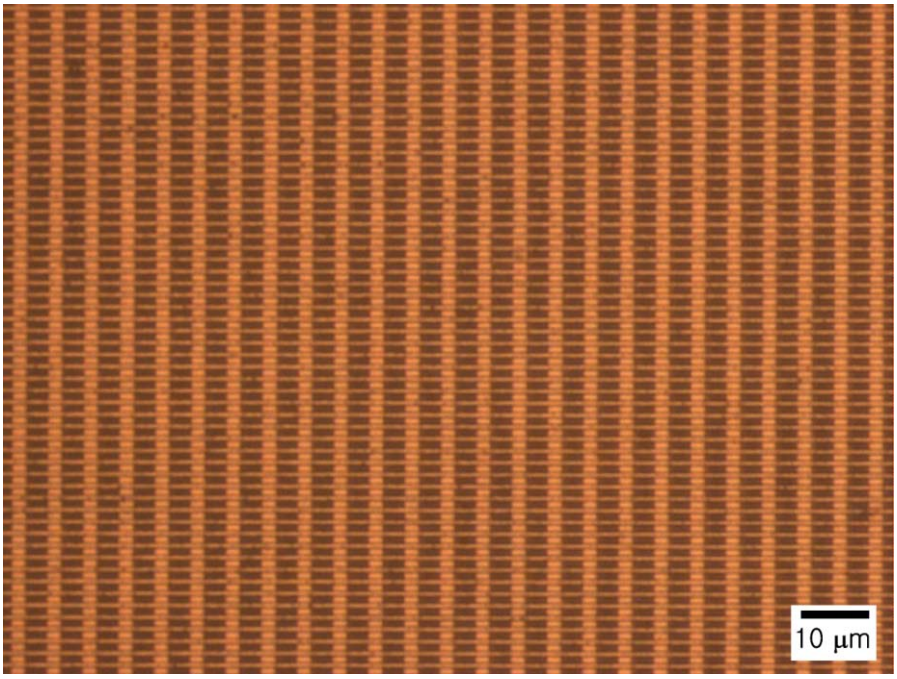

Figure S2. Optical microscopy of transferred Au line patterns with bi-layers.

4. Fabrication of organic thin film transistors (OTFTs) using transferred Au patterns as electrodes by pressure-assisted metal printing

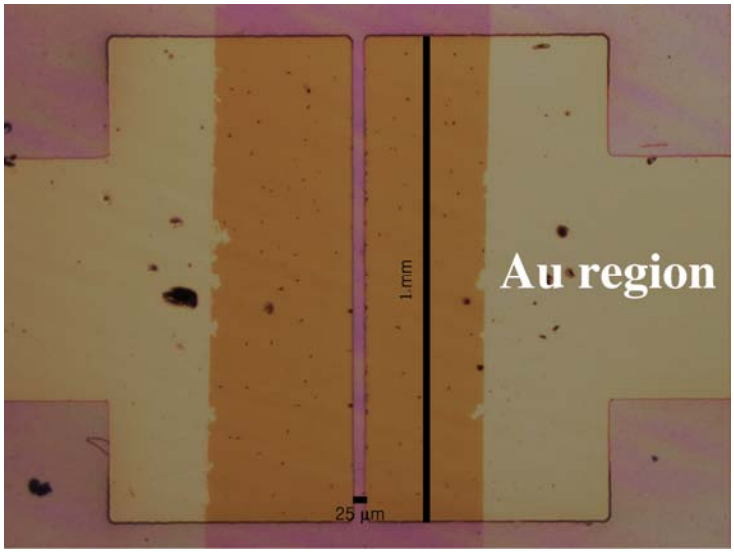

Figure S3. Optical microscopy of OTFTs using transferred Au electrodes.

5. The press machine for adopting pressure-assisted metal printing

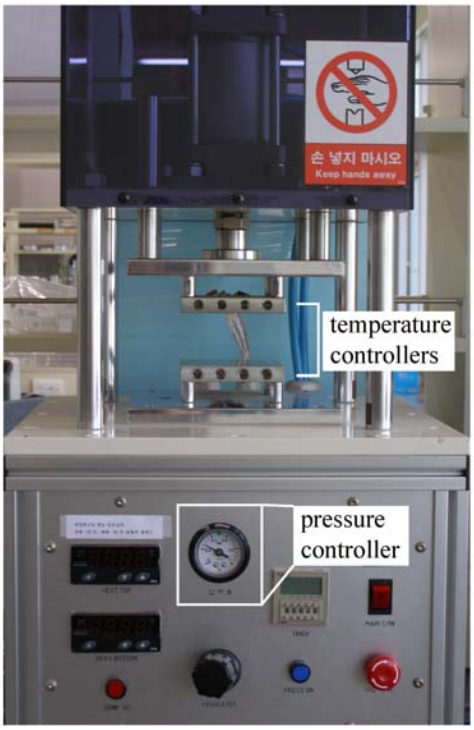

Figure S4. A photograph image of the press machine, which consists of two controllers: temperature controllers on the top of the stamp and bottom side of the substrate and a pressure controller. The machine simultaneously applies pressure and temperature.

Reference

[1] J. Park, Y. S. Kim and P.T. Hammond, *Nano. lett*. 2005, **5**, 1347.