Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supplementary Information

Low-temperature sintering highly conductive silver ink for flexible electronics

Kiesar Sideeq Bhat,[+] Rafiq Ahmad,[+] You Sheng Wang and Yoon-Bong Hahn*

School of Semiconductor and Chemical Engineering, Nanomaterials Processing Research Center, Chonbuk National University, 567 Baekjedaero, Deokjin-gu, Jeonju 54896, Republic of Korea.

*E-mail: ybhahn@chonbuk.ac.kr; Tel.: +82 63 270 2439; fax: +82 63 270 2360

[+] Equally contributed to this work.

Table S1. A comparative study of previously reported silver ink papers with our work.

Deposition Method	Sintering Conditions	Substrates	Conductivity (S/m)	Ref.
Inkjet reaction system	150 °C for 1 h (vacuum oven)	Glass	8.8028×10^6	25
Spin-coating, Stamping, printing	200 °C in air for 10 min	Glass	2.0×10^6	26
Inkjet printing	90 °C for 15 min	Glass, cellulose acetate, PI *etc.*	6.25×10^7	27
Inkjet printing	125 - 200 °C on hot plate for 5 min	Glass	2.08×10^7- 3.33×10^7	28
Inkjet printing	110 °C (boiling water)	PET	3.3003×10^7	29
Inkjet printing	200 °C (microwave irradiation)	PI	3.3003×10^6	30
Evaporative lithography	R.T. (HCl sintering)	Plastic	1×10^7	31
Micro-reactor assisted printing	R.T.	Glass and polymeric substrates	3.30×10^7	32
Inkjet printing and spin-coating	250 °C in air for 3h	PI	1.35×10^7	36
Pen writing	120 °C for 30 s 200 °C for 10 - 60 min	Sulphuric paper	3.06×10^5	37
Conductive pen writing	150 °C for 1h in oven	PI	5.55×10^6	38
Pen writing	200 °C in air for 60 min	Paper substrate	1.47×10^7	39
Spin-coating	R.T. (after 2 weeks)	Glass	2.50×10^6	Our work
Spin-coating	40 - 72 °C (hot-plate) for 15 min	Glass	4.5×10^5 - 2.20×10^6	Our work
Spin-coating	72 °C (hot-plate) for 15 min	PET	1.89×10^6	Our work
Spin-coating	72 °C (hot-plate) for 15 min	PI	1.62×10^6	Our work
Spin-coating	60 - 90 °C (oven) for 24 h	Glass	1.07×10^6 - 5.05×10^6	Our work
Nozzle-jet printing	75 °C (oven) for 1 h	PET	2.74×10^6	Our work

Table S2 Sheet resistance of SOP ink spin-coated, drop-casted and nozzle-jet printed films on different substrates.

Deposition method	Sintering conditions	Substrates	Sheet resistance (Ω/□)
Spin-coating	72 °C for 15 min on hot-plate	Glass	0.35
Spin-coating	62 °C for 15 min on hot-plate	Glass	0.84
Spin-coating	53 °C for 15 min on hot-plate	Glass	0.98
Spin-coating	48 °C for 15 min on hot-plate	Glass	1.436
Spin-coating	40 °C for 15 min on hot-plate	Glass	1.635
Spin-coating	90 °C for 15 min in oven	Glass	0.15
Spin-coating	80 °C for 15 min in oven	Glass	0.62
Spin-coating	70 °C for 15 min in oven	Glass	0.77
Spin-coating	60 °C for 15 min in oven	Glass	0.84
Spin-coating	72 °C for 15 min on hot-plate	PI	0.20
Spin-coating	72 °C for 15 min on hot-plate	PET	0.17
Drop-casting	R.T.	Glass	0.08
Nozzle-jet printing	75 °C for 1 h in oven	PET	0.33

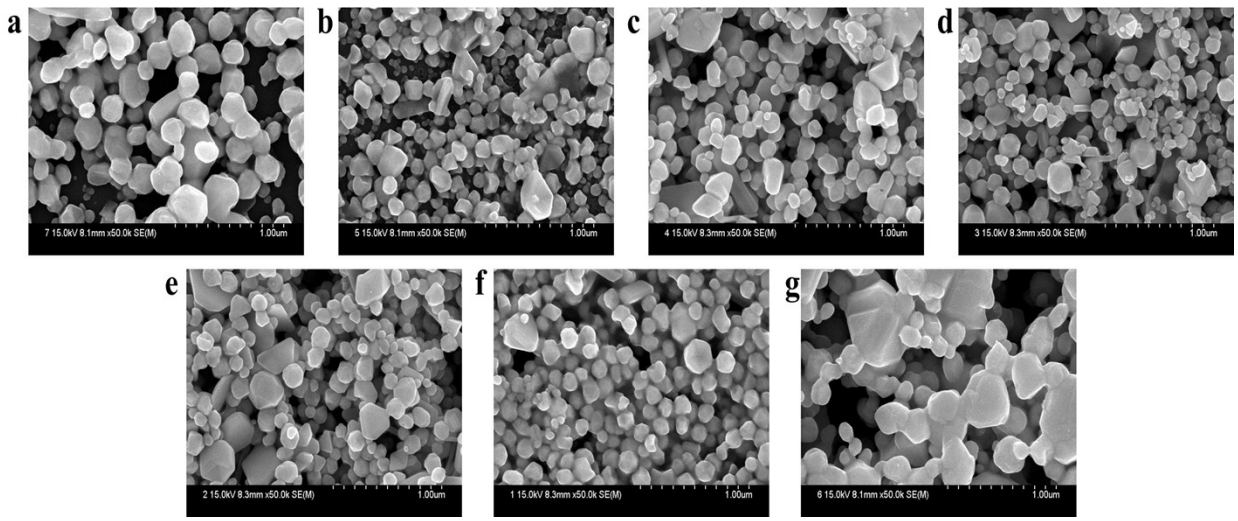

Figure S1. FESEM images of spin-coated glass films sintered on hot-plate at different temperatures i.e. at room temperature (a), 40 °C (b), 48 °C (c), 53 °C (d), 62 °C (e) and 72 °C (f) and DOD coated film at room temperature (g).

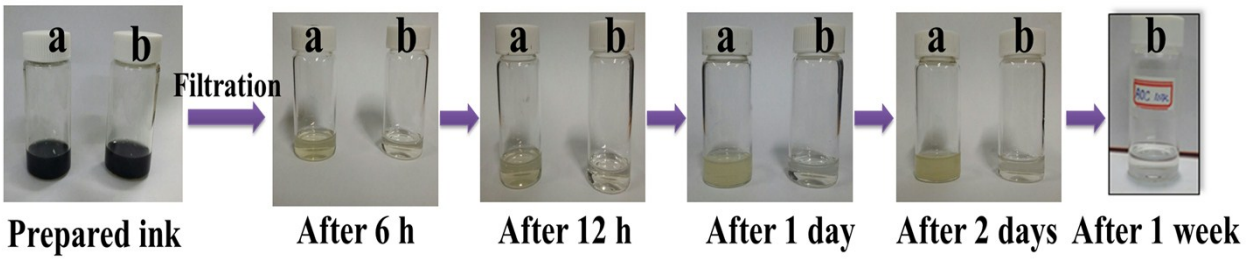

Figure S2. Optical images of the ink demonstrating ink stability; inks kept at room temperature (a) and at 4 °C (b).

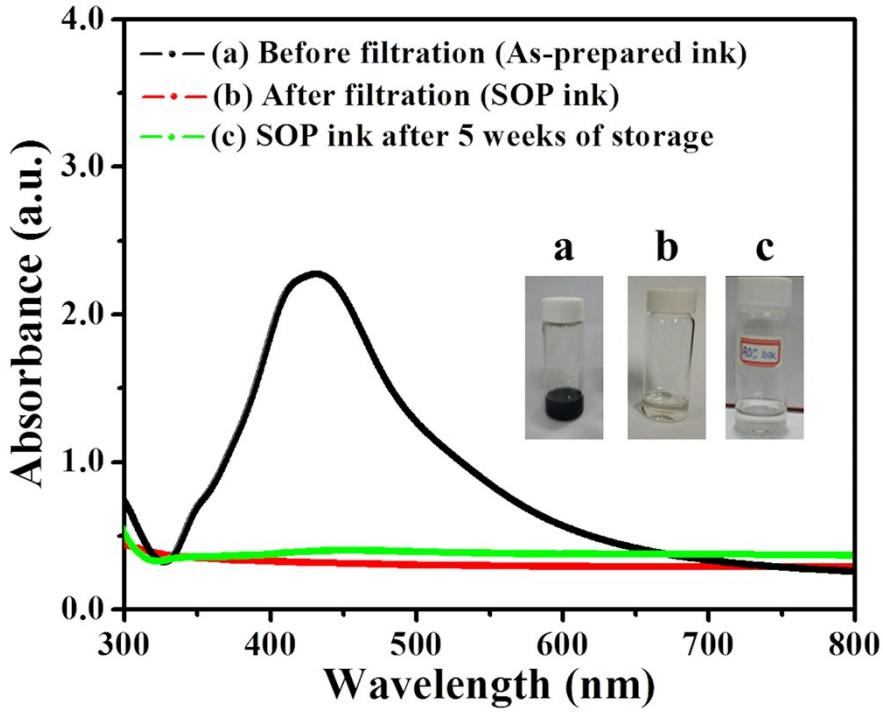

Figure S3. UV-visible spectra of as-formulated SOP ink (a) before filtration, (b) after filtration, and (c) after 5 weeks of storage at 4 °C. Inset shows the optical image of ink samples.

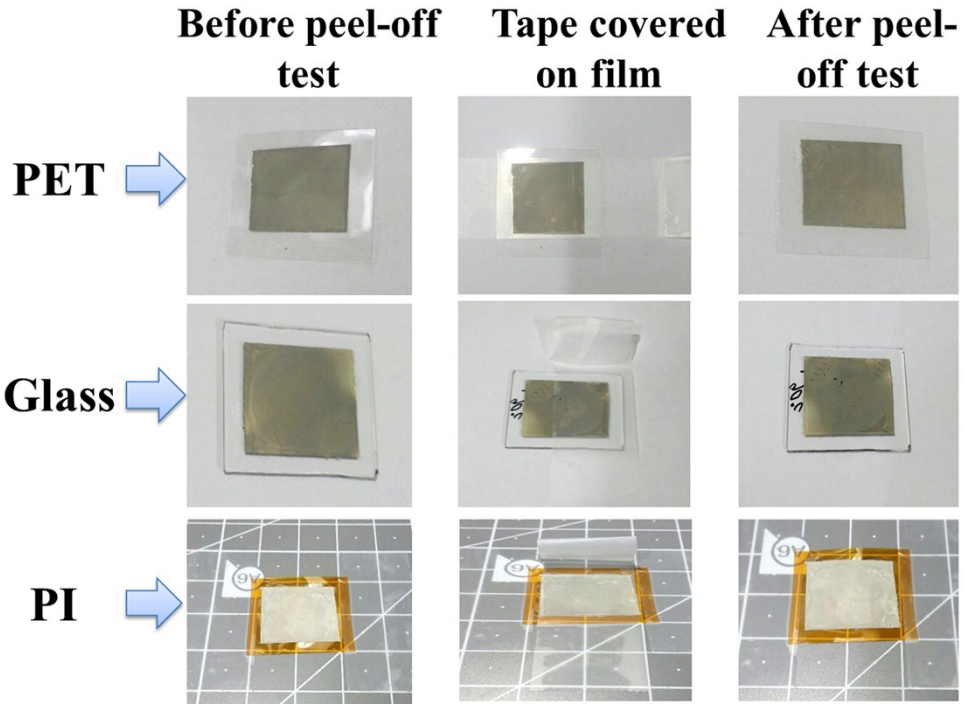

Figure S4. Optical images showing the tape/peel-off test of spin-coated films. (see Video 1)

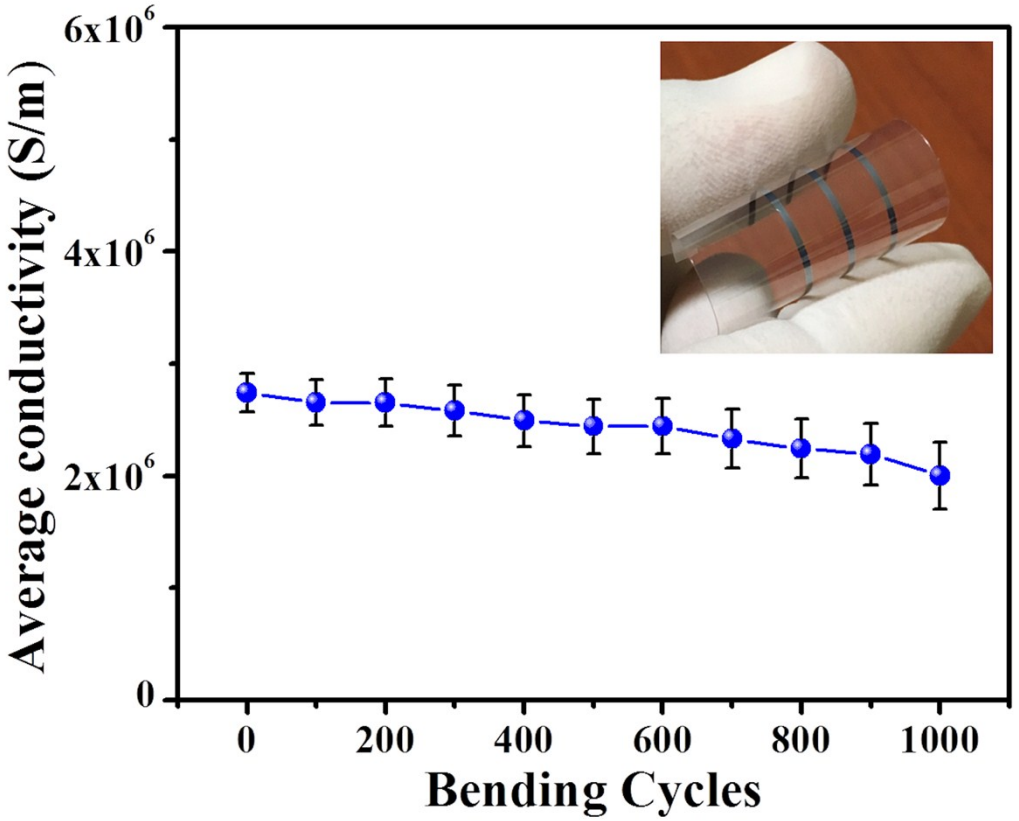

Figure S5. The average conductivity of printed tracks on PET substrate after repeated bending cycles. Inset shows the optical image of printed tracks on PET substrate bending outwards by ~90°.