Multifunctional Inks in Aerosol Jet Printing: Performance, Challenges, and Applications

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Supplementary Tables

Table S1: Conductive inks applications

DMF = N,N-imethylformamide; NMP = N-Methyl-2-pyrrolidone; PEO = polyethylene oxide; LiDFOB = Lithium Difluoro(oxalato)borate; LiTriflate = Lithium Trifluoromethanesulfonate; LiFePO4 = Lithium iron phosphate; EG = Ethelene glycol; [EMI][TFSI] = 1-ethyl-3-methylimidazolium bis-(trifluoromethylsulfonyl) amide; PS-PMMA-PS = poly(styrene-b-methyl methacrylate-b-styrene); EA = Ethyl Acetate; P3HT = poly(3-hexylthiophene); PVDF-TrFE = Polyvinylidene difluoride-trifluoroethylene; rGO = reduced graphene oxide; RTV = Room temperature vulcanizing; FR4 = Flame retardant glass-reinforced epoxy laminate; PET = Polyethylene terephthalate; COC = Cyclic olefin copolymer; POEGMA = Poly(oligoethylene glycol methacrylate); PBS = phosphate buffered serum; BSA = Bovine serum albumin; Anti-CEA = Anti-cancer embryogenic antigen antibody; DNA = Deoxyribonucleic Acid; HRP = enzyme horseradish peroxidase; PVP = poly(vinylphenol); pMSSQ = poly(methyl silsesquioxane); h-BN = Hexagonal boron nitride; HPMC = hydroxypropyl methylcellulose; SDBS = sodium dodecyl benzene sulphonate; PAA = Poly(pyromellitic dianhydride co-4,4′-oxydianiline) amic acid solution; NOA 81 = Norland Optical Adhesive 8; LCP = Liquid crystal polymer; Pebax = Polyether block amide; RuO2 = Ruthenium Oxide; POWs = polymer optical waveguides; NMP = n-Methyl-2-pyrrolidon; PLC = Polycaprolactone (PLC); GelMA = gelatin-methacryloyl; LTCC = Low Temperature Cofired Ceramic; PDMS = polydimethylsiloxane; NEA121 = Norland Electronic Adhesive 121; ITO = Idium Tin Oxide; RIE = Reactive Ion Etching

Ink Properties	Printing	Resolution	Post-processing	Substrate	Ref.
Au Ink	UA	W: 120 µm; G: 80 µm; T: 0.08 ~ 0.1 µm	300 °C for 5 hrs	Glass	[1]
Au Ink	UA 100 µm nozzle	W: 15 µm;	240 °C for 1 hr	GaAs wafer	[2]
Au NP: 30 ~ 120 nm; 25 wt%; η = 8 cP	UA; Current: 462 mA; Nozzle: 150 µm; S = 0.6 mm/s; Q_s = 35 sccm; Q_a = 27 sccm;	W: 25 µm;	120 °C for 1 hr 250 °C for 4 hrs	PI	[3]
Au NP: < 50 nm; η < 10 cP; T = 30 ± 3 mN/m;	UA S = 1 mm/s	W: 25 ± 2 µm; T: 0.10 ~ 0.15 µm	120 °C for 1 hr 250 °C for 4 hrs	PI	[4]
Au NP: D50 < 60 nm; 40 wt%; d = 1.23 g/cm^3	UA; Current: 305 mA; Nozzle: 150 µm; S = 3 mm/s; Q_s = 70 sccm; Q_a = 15 sccm;	W: 25 µm; G: 25 µm; T: 8.04 µm;	100 °C for 0.5 hr	PI	[5]
Au NP Ink; 25 wt%; UT Dots, Inc. UTD-Au25;	UA; Current: 500 mA; Nozzle: 3 mm; Q_s = 150 sccm; Q_a = 130 sccm;	Large area; G: 150 µm;	280 °C for 1 hr	Glass, PI;	[6]
Au NP; Au-LT-20: 3-5 nm; UTDAu: 80 nm	UA	W: 400 µm		Glass, PDMS	[7]
Au ink		W: 25 µm;	300 °C for 5 hr	Glass	[1]
Au NP ink	UA; Nozzle: 100 µm	W: 15 µm;	240 °C for 1 hr	GaAs (gallium, arsenic)	[8]
Ag NP: D50: 30 ~ 50 nm; 40 wt%; d = 1.7 g/cm^3	UA; Current: 400 mA; Nozzle: 150 µm; S = 2 mm/s; Q_s = 20 sccm; Q_a = 42 sccm;	W: 25 µm; G: 25 µm; T: 1.48 µm;	200 °C for 1 hr	PET	[5]
Ag NP: < 60 nm; 45 ~ 55 wt%; η = 50 ~ 100 cP	PA; Q_e = 680 sccm; Nozzle: 150 µm; S = 5 mm/s; Q_s = 40 sccm; Q_a = 700 sccm; Q_e = 680 sccm;	W: 17 µm;	832 nm IR laser at 100 mW	Glass	[9]
Ag NP: 10 ~ 20 nm; η = 12 cP; Clariant Prelect TPS 50G2	UA: Nozzle: 100 µm; T_s = 25 °C; Q_s = 35 sccm; Q_a = 18 sccm;	W: 10 µm; T: 1 µm;	120 °C for 30 min 140 °C for 2 hr	PI	[10]
Ag NP: 10 ~ 20 nm; η = 12 cP; Clariant Prelect TPS 50G2	UA: Nozzle: 150 µm; T_s = 80 °C; S = 2 mm/s; Q_s = 90 sccm; Q_a = 40 sccm;	W: ~ 30 µm; T: ~ 2 µm; 10 layers	200 °C for 2 hrs	PI, Glass	[11]

Ag NP Ink; Cabot AgNP solution	UA; Volt: 50 V; Q_s = 50 sccm; Q_a = 13 sccm;	W: 45 ± 2 μm; T: 1.12 ± 0.02 μm;	180 °C for 30 min	PI	[12]
Ag NP Ink; 40 wt%; UTDots, Inc. Ag40X;	UA; Current: 430 mA; Nozzle: 3 mm; Q_s = 200 sccm; Q_a = 150 sccm;	Large area; G: 150 μm;	200 °C for 1 hr	Glass, PI;	[6]
Ag NP Ink; < 10 nm; 25 ~ 60 wt%; η = 1 ~ 30 cP; UTDots, Inc.	PA; Nozzle: 200 μm; T_s = 60 °C; S = 2 mm/s; Q_s = 20 sccm; Q_a = 550 sccm; Q_e = 570 sccm;	W: 60 μm; T: 6.8 μm;	220 °C for 10 min	Glass	[13]
Ag NP; 10 ~ 20 nm; in EG; η = 10 cP;	UA; Current: 512 mA; T_s = 50 °C; Nozzle: 150 μm; S = 1 mm/s; Q_s = 40 sccm; Q_a = 20 sccm;	W: ~ 100 μm; T: 0.25 μm;	200 °C for 1 hr	PI	[14]
Ag NP; 10 ~ 20 nm; η = 12 cP; Clariant Prelect TPS 50	UA; Nozzle: 150 μm; Q_s = 55 sccm; Q_a = 30 sccm;	W: ~ 25 μm;	150 °C for 12 hr or 200 °C for 3 hrs	PI	[15]
Ag NP; Clariant	PA; Nozzle: 300 μm; Q_s = 60 sccm; Q_a = 30 sccm;	W: 70 μm;	830 nm IR laser at 100 mW	PI;	[16]
Ag NP Ink; ~ 20 nm; 40 wt%;	UA; Nozzle: 100 μm; T_s = 60 °C; Q_s = 25 sccm; Q_a = 15 sccm;	W: ~ 50 μm;	150 °C for 1 hr	SiO_2/Si; PI;	[17]
Ag NP Ink; Clariant	PA; S = 2 mm/s;	W: 100 μm;	150 °C for 20 hrs	Si chip & FR4;	[18]
Ag nanoflakes Ink; 55 ~ 60 wt%; HPS-030AE1;	PA: T_s = 45 °C; S = 2 mm/s; Q_s = 40 sccm; Q_g = 650 sccm; Q_e = 610 sccm;	T: 1.85 μm;	832 nm IR laser 100 mW & 30 μm	Glass, PET	[19]
Ag nanoflakes Ink; 55 ~ 60 wt%; HPS-030AE1;	PA: T_s = 60 °C; S = 2 mm/s; Q_s = 50 sccm; Q_g = 1350 sccm; Q_e = 1300 sccm;	W: 70 μm; T: 1.85 μm;	832 nm IR laser 100 mW & 30 μm	Copper plane	[19]
Ag nanoflakes Ink; 55 ~ 60 wt%; HPS-030AE1;	PA; Nozzle: 150 μm; T_s = 60 °C; S = 3 mm/s; Q_s = 50 sccm; Q_g = 1150 sccm; Q_e = 1100 sccm;	W: 15 μm; G: 10 μm;	832 nm IR laser 100 mW & 30 μm	Copper plane	
Ag nanoflakes Ink; Novacentrix (Metalon HPS-030 AE1)	PA;	W: 50 μm; T: 5 μm;	210 °C for 2 hrs	Interconnect on test chips	[20]

Ag nanoflakes Ink; (Metalon HPS-030 AE1), 55 ~ 60% loading,	PA; T_s = 60 °C; S = 2 mm/s; Q_s = 50 sccm; Q_a = 1350 sccm; Q_e = 1300 sccm;	W: 70 µm; 1 layer;	832 nm IR laser 100 mW & 30 µm	SU-8 traces	[21]
Ag NW Ink; 10 mg/mL;	UA; Current: 350 mA; Nozzle: 200 µm; T_s = 30 °C; Q_s = 25 sccm; Q_a = 35 sccm;			POEGMA coated glass	[22]
Ag NW Ink; 10 mg/mL; HPMC & EG;	UA; Current: 370 mA; Nozzle: 200 µm; T_s = 80 °C; S = 2 mm/s; Q_s = 25 sccm; Q_a = 35 sccm;	T: ~ 1 µm;	80 °C for 10 min	CNT tracks on PI;	[23]
Ag NP (solvent free); D_{avg} = 44 nm;	Spark Discharge; Nozzle: 100 µm; S = 0.17 mm/s; Q_s = 35 ~ 100 sccm;	W: 86 µm; T: 12 µm;	450°C for 1 hr	Glass	[24]
Ag NP: 20 ~ 80 nm	Dry AJP; T_s = 25 ~ 250 ºC; S = 0.117 mm/s; Q_s = 90 sccm; Q_a = 30 sccm	G: 500 µm; 5 layers		Plastic	[25]
Ag nano-flakes (Metalon HPS-108AE1); ⌀ = 400 ~ 700 nm; η= 130 ~ 180 cP	PA; Volt: 200 ~320 V; Nozzle: 300 µm; S = 1 mm/s; Q_s = 150 sccm; Q_a = 1100 sccm; Q_e = 1020 sccm	W: 118 µm; T: 12.87 µm; 15 layers	20 °C for 24 hrs	PET, PE, PVC, PLA, PI	[26]
Ag NP: 5 ~ 150 nm	Dry AJP; Ts = 25 ~ 300 oC; S = 0.117 mm/s; Q_s = 90 sccm; Q_a = 30 sccm;	G: 500 µm; 5 layers		Silicon	[27]
Ag; cured at 220 °C for 10 min	PA; Nozzle: 50000 µm; T_s = 60 ºC; S = 2 mm/s; Q_s = 50 sccm; Q_a = 810 sccm; Q_e = 830 sccm	T: 6.8 µm; 1 layer	−0.12 V for 10 s	Alumina	[28]
AgCl; cured at 120 °C for 30 min	PA; T_s = 65 ºC; S = 2 mm/s; Q_s = 130 sccm; Q_a = 550 sccm; Q_e = 600 sccm	T: 4 µm; 1 layer	−0.12 V for 10 s	Alumina	[28]
Ag NP TPS 35 HE; 20 wt.%	UA; Current: 660 mA; Volt: 48 V; Nozzle: 100 µm; Q_s = 32 sccm; Q_a = 14 sccm	W: 9.8 µm; T: 1.8 µm	200 °C for 60 mins	Glass	[29]
Ag Ink	Nozzle: 150 µm ~ 300 µm	T: 3 µm; 2 layers	< 180 °C for 6 hrs	LCP	[30]
Ag NP	Nozzle: 150 µm ~ 300 µm	T: 3 µm; 6 layers	< 180 °C for 2 hrs	PI	[30]
Ag Ink; T = 30 °C	UA; Current: 470 mA; Nozzle: 300 µm; T_s = 30 oC; S = 5 mm/s; Q_s = 50 sccm; Q_a = 50 sccm	W: 150 µm	200 °C for 60 mins	PETE Foam; EX1541; Loctite 3104	[31]

Bando FlowMetal MA07-2; T = 30 °C	UA; Current: 470 mA; Nozzle 300 µm; S = 5mm/s; Q_s = 50 sccm; Q_a = 50 sccm;	W: 100 µm	200 ◦C for 60 min	EX1541	[31]
ANP 1:4 Dilution w Ethanol (EtOH); T = 30 °C	UA; Current: 470 mA; Nozzle 300 µm; S = 5mm/s; Q_s = 50 sccm; Q_a = 50 sccm;	W: 200 µm;	200 ◦C for 60 min	EX1541; Loctite 3104	[31]
PVNanoCell SICRYS 160PM-116;	UA; Nozzle 200 µm; S = 5 -10mm/s; Q_s = 50 sccm; Q_e = 790 sccm;	10 µm x 25 µm; 11 µm x 36 µm;	Laser 900mA, 5mm/s, 1 pass	Loctite 3104; EX1541	[31]
PVNanoCell SICRYS 160PM-116;	UA; Nozzle 250 µm; S = 10mm/s; Q_s = 50 sccm; Q_a = 900 sccm; Q_e = 840 sccm;		Laser 900mA, 5mm/s, 1 pass, 50 µm pitch; 26.7min	Loctite 3104 over EX1541	[31]
PVNanoCell SICRYS 160PM-116;	UA; Nozzle 250 µm; S = 10mm/s; Q_s = 50 sccm; Q_a = 900 sccm; Q_e = 840 sccm;		200 ◦C for 60 min	Loctite 3104 over EX1541	[31]
Ag NP (Clariant Prelect TPS50 G2)	PA; Nozzle: 750 µm; T_s: ambient; S = 4 mm/s; Q_s = 80 sccm; Q_a = 1400 sccm; Q_e = 1200 sccm	W: 25 µm	200 °C for 30 mins	PI, Glass	[32]
Ag Ink	PA; Power: 100 mW; Nozzle: 300 µm; S = 10 mm/s; Q_s = 60 sccm; Q_a = 30 sccm	W: 70 µm; T: 1 µm		PI (Kapton)	[33]
Ag NP Inks	PA; Volt: 350 ~ 400 V	W: < 100 µm	> 1000 °C, milliseconds (Photo-thermal effect)	Polylactic acid	[34]
Ag NP Inks; 1750 g/L ; 40 ± 2 w%; η= 1.5 cP; 30 ~ 50 nm	UA; Nozzle: 100, 150, 200 µm; T_s = 90 ~ 110 ºC; Q_s = 40 sccm; Q_a = 28 sccm	W: 3000 µm	80 °C for 24 hrs 200 °C for 30 mins	Alumina	[35]
Ag Ink; 10% conductivity	UA	W: 10 µm; T: 4 µm	65 °C for 1.5 hrs; Plasma for 1 min; 97% Argon, 3% SF6	SiO_2	[36]

Ag NP ink;	UA; Nozzle 100 µm; S = 2 mm/s; Q_s = 12 sccm; Q_a = 50 sccm	W: 30 µm;	120 °C for 5 min 150 °C for 15 min	PET	[36]
Ag NP Ink (Paru PG-007); 70 w%; 50 mN/m	PA; S = 4 ~ 6 mm/s	T: 16 ~ 17 µm	150 °C for 1 hrs	Ceramic fillers, Polytetrafluoroethylene-based materials, LCP	[37]
UTDAg40 nano ink; 20 ~ 60 wt%; η= 1 ~ 30 cP; 8 ~ 15 nm	Nozzle: 750 µm; T_s = 120 ~ 300 ºC; S = 4 mm/s		200 °C for 1h	PI Kapton foil	[38]
Ag NP	PA; Nozzle: 300 µm; S = 10 mm/s; Q_s = 10 - 100 sccm; Q_a = 600 - 800 sccm; Q_e = 600 - 775 sccm	W: 175 ± 5 µm; T: 0.92 ± 0.05; and 3.25 ± 0.07 µm;	Drying ambient conditions 30 min; 20 °C for 30 min then 120 °C for 1 hr	PC, ABS, PVC	[39]
Ag ink DGP-40LT-15C;	UA; Nozzle 100 µm; S = 5 mm/s; Q_a = 20 sccm		140°C for 1 min	PEDOT: PSS (PH1000) covered glass	[40]
Ag NP ink; UTDots UTDAg PA; 40 - 60 wt%;	PA; T_s = 70 °C;	W: 135 µm;	220 °C for 30 min	PI Kapton	[5]
ACURA E8074 (Ag NP-filled epoxy)	PA	W: 40 µm; T: 30 µm		PI diluted with NMP	[41]
Ag NP (PRELECT TPS 50, Clariant); cured in Ethanol	UA ;Current: 0.4 ~ 0.6 A; T_s = 70 ºC; Q_s = 0 sccm; Q_a = 15 ~ 20 sccm	W: 20 µm	200 ºC for 60 mins	PI	[42]
Ag NP ((Perfect-TPS 50 G2); 40 ± 2 wt%; η= 1.5 cP; 30–50 nm	UA; Nozzle: 200 µm; Q_s = 50 sccm; Q_a = 25 sccm	W: 540 µm ± 2.5%; T: 17 µm	200 ºC for 60 mins Or 30 min followed by 200 °C for 6 hr	Glass	[43]

Ag NP UT25Te ink (UTDots corp); 25 wt%; η= 2 cP	UA; Nozzle: 150 µm; T_s = 60 ºC; S = 0.025 mm/s; Q_s = 32 sccm; Q_a = 8 ~ 10 sccm		500 W halogen lamp for 2 min	PI Kapton	[8]
Ag NP; Metalon HPS030 AE1	PA	W: 34 µm; G: 23 µm; T: 5 ~ 6 µm	600 ºC for 4 mins	LTCC	[44]
AgCl (XA-3773); Ag/AgCl weight proportion ratio of 8/2; η = 19.5 cP at 23 °C;	PA; Nozzle: 200 µm; T_s = 65°C; S = 2 mm/s; Q_s = 55 sccm; Q_a = 750 sccm; Q_e = 720 sccm	W: 51.8 ± 3.5% µm; T: 2.71 ± 3% µm;		Alumina	[45]
Ag NF (Metalon HPS030 AE1)	PA; Nozzle 200 µm; T_s = 60 °C	W: 93 µm; G: 36 µm; T: 5 µm	30 mW/cm^2 UV curing for 2 minutes 200 °C for 2 hr	Borosilicate Glass, Epoxy	[46]
Ag NP (PRELECT® TPS50); 50 ± 2 wt%; 1800 mg/mL; η= 50 ± 20 cP; 30–50 nm	Nozzle: 750 µm; S = 4 mm/s		200 ºC for 60 mins	PI DuPont Kapton HN500 foil	[47]
Ag NP	UA; Nozzle: 100 µm; S = 2 mm/s; Q_s = 12 sccm; Q_a = 50 sccm	W: 30 µm	120 ºC for 5 mins, 10 layers	PET	[48]
Ag Micro PE PG-007MOP in ethylene glycol; 50 wt%	PA; Nozzle: 150 µm; T_s = 200 ºC; S = 1.7 mm/s; Q_s = 100 sccm; Q_a = 50 sccm	W: ~25 µm; T: 40 µm	25 layers	Glass	[49]
Ag NP	S = 10 ~ 15 mm/s			Cu Rogers RO4350	[50]
Ag NP	Nozzle: 100 µm	W: 100 µm, 50 µm, 25 µm, 10 µm; G: 3 ~ 4µm; T: 3 ± 0.5 µm; 2 layers	300 ºC	Alumina	[51]
Ag25Te ink from UTDots	UA; Volt: 45 V; Nozzle: 100 µm; S = 1.5 mm/s; Q_s = 58 sccm; Q_a = 10 sccm	W: 20 ~ 30 µm; T: 2 µm	500 W halogen lamp for 2 min	PI Kapton	[52]
Ag self-made ink composition 74T; η= 2.6 cP	UA: Nozzle: 150 µm; S = 1.5 mm/s; Q_s = 32 sccm; Q_a = 8 ~ 10 sccm	T: 1.16, 1.02, 0.86 µm; 4 layers		Glass	[53]
Ag NP (Prelect TPS 50 G2—Clariant)	UA; Current: 0.6 mA; Nozzle: 150 µm; T_s = 20 ~ 100 ºC; S = 0.1 ~ 10 mm/s; Q_s = 20 ~ 160 sccm; Q_a = 20 ~ 32 sccm		200 ºC for 2 hrs	Si wafer, Glass, PI	[54]

CSD-32 Ag nano-dispersion; η= 100 cP; 60 nm	Power: 700 mW	W: 100 μm; T: 3 μm; 2 layers	80 °C for 3 hrs then 150 °C for 5 mins	PI, FR4, PC, ABS	[55]
Nano Ag ink (UTDAg40X); 40 wt%; η= 40 cP; 10 nm	T_s = 120 ~ 140 ºC	W: 60 ~ 65 μm; T: 8 ~ 10 μm	130 ºC for 120 mins	PET, PC, PI	[56]
Ag NP Ink (Sigma Aldrich, MO)		T: 10 ~ 20 μm	200 ºC for 2 hrs	CNTs	[57]
Ag Ink	PA; Nozzle: 100 ~ 300 μm	W: 500 μm; T: 100 μm	180 °C for 120 mins	AIN Ceramic	[58]
Ag Ink; 35 wt%, η= 2 ~ 2.5 cP	UA: Nozzle: 250 μm; T_s = 100 ºC	5 layers	180°C for 1 ~ 2 hrs	PI Kapton	[59]
Ag NP Ink; 50 wt%; η= 10 ± 2 cP; 30 ~ 50 nm	UA; Current: 500 mA; Nozzle: 150 μm; T_s = 40 ºC; S = 7 mm/s; Q_s = 30 sccm; Q_a = 30 sccm	W: 20 μm; T: 1 μm	200 ºC for 2 hrs	PI, Sylgard and Ecoflex	[60]
Ag NP (Clariant); 30 nm	T_s = 70 ºC	T: 1 μm	200 ºC for 2 hrs	PU, Glass	[61]
Ag fillers in Si ink (127-30, Creative Materials); η= 250 cP	PA; Nozzle: 300 μm; T_s: 50 ºC; S = 1 mm/s; Q_s = 60 sccm; Q_a = 1000 sccm; Q_e = 940 sccm	W: 84 μm	170 ~ 180 ºC	Si rubber	[62]
Ag NP (PV Nanocell); 60 wt%; η= 26 cP; 75 ~ 100 nm	PA; Nozzle: 300 μm; T_s: 50 ºC; S = 5 mm/s; Q_s = 40 sccm; Q_a = 800 sccm; Q_e = 750 sccm	W: 100 ~ 160 μm; T: 4 ~ 6 μm	200 ºC for 60 mins	PI; Glass	[63]
Ag NP (DOWA DF-SLO-002) in butyl carbitol; 73.4 wt%; η= 1100 cP	PA; Nozzle: 300 μm; T_s: 50 ºC; S = 1 mm/s; Q_s = 30, 40, 50 sccm; Q_a = 1370, 1350, 1335, 1320, 1300 sccm; Q_e = 1400 sccm	W: 119 ~ 180 μm; T: 1 ~ 6.9 μm	200 ºC then 80 ºC	NEA121	[64]
Clariant Prelect 50 Ag NP in Ethylene glycol; η= 15 cP; 1800 mg/mL; 70 nm	UA; Nozzle: 150 μm; T_s: 20 ºC; S = 0.5 mm/s; Q_s = 75 sccm; Q_a = 20 sccm	5 layers	200 ºC for 60 mins	Glass	[65]
Paru PG-007 Ag NP Ink	PA; Nozzle: 200 μm; T_s: -70 ~ 22 ºC; S = 8 mm/s	W: 80 μm; T: 5 μm	200 ºC for 60 mins	PI Kapton and Upilex	[66]
Ag NP in Ethylene glycol (Clariant Prelect TPS 50 G2); η= 30 cP	UA; Nozzle: 200 μm; T_s: 20 ºC; S = 1.5 mm/s; Q_s = 90 sccm; Q_a = 22 sccm	W: 50 μm; T: 2 μm, 2 layers	180 ◦C for 3 hrs	LCP	[67]

Ag NP (Silverjet DGP-40LT-15C from Sigma-Aldrich); η= 10 ~ 18 cP; 50 nm	UA; Nozzle: 100 μm; T_s: 120 ºC; S = 5 mm/s; Q_s = 10 sccm; Q_a = 12 sccm	W: 10 μm		PET	[68]
Ag Ink (TPS 50G2); 35 wt%	UA; Nozzle: 150 μm; Q_s = 32 ~ 34 sccm; Q_a = 22 ~ 24 sccm	W: 20 ~ 40 μm; G: 30 ~ 50 μm; T: 1 ~ 2 μm	140 ◦C for 1 hr	PI kapton, LCP, Glass	[69]
Ag Np Ink	SLA	W_{min}: 100 μm; W_{max}: 3000 μm; T: 10000 μm	100 ◦C for 1 hr	Formlabs GPCL02 resin	[70]
Ag NP (EXPT Prelect TPS 50);	10 μm resolution	T: 1.37 μm; 3 layers	200 ◦C for 1 hr	LCP. CPW	[71]
Ag NP Ink (Clariant Prelect TPS 50 G2); η= 10 cP	UA; Nozzle: 150 μm; Q_s = 50 sccm; Q_a = 23 sccm	W: 25 μm; T: 3 μm, 2 layers	180 ◦C for 3 h	LCP	[72]
AgNW Organic-based	PA; S = 0.1 ~ 0.6 mm/s; Q_s = 270 sccm; Q_a = 600 sccm; Q_e = 590 sccm	W: 107.2 ~ 142.9 μm	140 ◦C for 5 mins		[73]
AgNW Water-based	PA; Nozzle: 200 μm; S = 0.4 mm/s; Q_s = 270 sccm; Q_a = 600 sccm; Q_e = 590 sccm	W: 50.9 ~ 71.3 μm	100 ◦C for 10 mins	ITO Glass	[73]
Ag NP	PA; Nozzle:50 μm; S = 1 mm/s	T: 3 μm, 2 layers	150 °C for 3 hrs	LCP	[74]
HPS 108-AE1 (Ag flakes)	PA; T_s = 35 ºC; S = 1 mm/s; Q_s = 500 sccm; Q_a = 1350 sccm; Q_e = 1000 sccm	W: 1000 μm; 10 layers (Chromatographic paper, cardboard); 5 layers (Photographic paper)	140 °C (oven dried)	Chromatographic paper, Photographic paper, Packaging cardboard	[75]
Ag (Micro PE PG-007MOP) in Ethylene glycol; 50 w%	UA; Nozzle: 100, 150, 300 μm; S = 100 mm/s; Q_s = 20, 40, 100 sccm; Q_a = 23 sccm	W: 20 μm; T: 6.3 μm		PI	[76]
Ag NP	UA; Nozzle: 100 μm; S = 2 mm/s; Q_s = 10 sccm; Q_a = 15 sccm	W: 13.6 ± 0.2 μm	200 ◦C for 2 hrs	PI	[77]

Ag NP	PA; Nozzle: 100 µm; T_s= 80 ºC ; S = 5 mm/s; Q_s = 70 sccm; Q_a= 500 sccm; Q_e = 540 sccm	W: 50 ± 5 µm	200 ºC for 2 hrs	PI	[77]
Ag NP; η= 10 cP	UA; Current: 0.5 mA; Nozzle: 150 µm; T_s: 50 ºC; S = 1 mm/s; Q_s = 40 sccm; Q_a = 20 sccm	W: 200 µm	30 W plasma-oxygen for 2 mins 200 ◦C for 1 hr	PI kapton	[78]
Ag NP (Metalon JS-A221AE ink); 50 w%; η= 10 ~ 20 cP; 35 nm	UA; Nozzle: 300 µm; T_s: 23 ºC; S = 10 mm/s; Q_s = 45 sccm; Q_a = 55 sccm	5 layers	110 ºC for 180 mins	Glass, Natural ABS	[79]
Ag NP Ink	UA; Current: 540 mA; Nozzle: 200 µm; T_s = 25 ºC; S = 5 mm/s; Q_s= 80 sccm; Q_a= 18 sccm	W: 40 µm, 8 layers	150 ºC for 15 mins	PI	[80]
Ag NP in Ethylene glycol; η= 25 ± 2 cP; 30 ~ 50 nm	UA; Q_s = 10 sccm; Q_a= 4000 sccm	2 × 2 mm^2		Glass, PEL P60 paper	[81]
Ag NP; η= 5.9 cP	UA; Nozzle: 300 µm; T_s: 40 ºC	1 layer	200 oC for 1 hr	Glass	[82]
AgNPs based; 40 ~60 wt%; η= < 10 cP	UA; Nozzle: 300 µm; T_s = 25 ºC; S = 6 mm/s; Q_s = 75 sccm; Q_a= 20 sccm	PET: W: 100 µm; 2, 5, 10 layers; SLA: W: 150, 800 µm; 7 layers	PET: 200 ºC for 2 hrs; SLA: 150 ºC for 2 hrs	PET, SLA substrate	[83]
Al Ink: (Al-IS1000) η = 80 ~ 120 cP	PA; T_s = 20 °C; Q_s = 90 sccm; Q_a = 1035 sccm; Q_e = 1000 sccm;	60 µm × 240 µm	100 °C for 30 min 800 °C for 2 min	Si wafer	[84]
Al ink (Al-IS1000); η = 80 ~ 120 cP;	PA; T_s = 20 °C; Q_s = 90 sccm; Q_a = 1035 sccm; Q_e = 1000 sccm	W: 100 µm; T: 10 µm;	100 °C for 30 min 800 °C for 2 min	Glass	[84]
Graphene ink; 30 mg/mL	UA; Nozzle: 100 µm; S = 5 mm/s; Q_s = 40 ~ 60 sccm; Q_a = 15 ~ 45 sccm	W: 40 µm	350 °C for 30 min	PI	[85]
Water-based Ag nano-flakes (Metalon HPS030 AE1); η= 187 cP	PA; Nozzle: 200 µm	W: 50 µm; T: 5 µm; 4 layers	200 °C for 2 hrs	Glass	[86]

PTB7:PC70BM;	UA; S = 2 - 16 mm/s; T_s = 22 °C; Q_s = 10 sccm; Q_a = 17 sccm	T: 0.05 µm;	80 ◦ C for 5 min 20 ◦ C for 1h under vacuum	ITO covered glass	[40]
Pt NP Ink; ~ 100 nm; η = ~ 10 cP;	PA; Q_s = 50 sccm; Q_a = 20 sccm;	W: 50 µm; T: 6.7 µm;	150 °C for 20 min 900 °C for 30 min	Al_2O_3 Membrane	[87,88]
Metallic CNT Ink; 0.5 mg/mL; P3-SWNTs - Carbon Solution Inc.	UA; Current: 370 mA; Nozzle: 150 µm; Q_s = 35 sccm; Q_a = 25 sccm;	Large area; G: 150 µm;	150 °C	Glass;	[6]
rGO in Propanol + Terpineol; 3 mg/mL;	UA; Current: 600 ~ 610 mA; S = 2 ~ 100 mm/s; Q_s = 800 sccm; Q_a = 500 sccm;	Large area; 6 layers;	140 °C for 3 min	Silicone;	[89]
AgCl Ink; η = 30,000 cP diluted by thinner.	PA; Nozzle: 200 µm; T_s = 65 °C; S = 2 mm/s; Q_s = 30 sccm; Q_a = 530 sccm; Q_e = 570 sccm;	W: 60 µm; T: 4 µm;	120 °C for 30 min	Glass	[13]
AgCl Ink; η = 30,000 cP diluted by thinner.	PA; Nozzle: 200 µm; T_s = 65 °C; S = 2 mm/s; Q_s = 55 sccm; Q_a = 750 sccm; Q_e = 720 sccm;	W: 60 µm; T: 4 µm;	120 °C for 30 min	Glass	
Carbon Ink; η = 15,000 ~ 20,000 cP;	PA; Nozzle: 200 µm; T_s = 70 °C; S = 2 mm/s; Q_s = 110 sccm; Q_a = 900 sccm; Q_e = 1000 sccm;	W: 60 µm; T: 6.5 µm;	115 °C for 5 min	Glass	[13]
Carbon Ink; η = 15,000 ~ 20,000 cP;	PA; Nozzle: 200 µm; T_s = 70 °C; S = 4 mm/s; Q_s = 40 sccm; Q_a = 805 sccm; Q_e = 770 sccm;	W: 60 µm; T: 6.5 µm;	115 °C for 5 min	Glass	
CNT Ink	PA; Nozzle: 300 µm; Q_s = 50 sccm; Q_a = 25 sccm	W: 80 µm; T: 0.5 µm		PI (Kapton)	[33]
WSe2	UA; Power: 500 mW; Nozzle: 300 µm; Q_s = 50 sccm; Q_a = 35 sccm	⌀: 1.2 ~ 0.243 µm, T: 0.3 µm		PI (Kapton)	[33]

RuO_2 (ESL-3111)	UA	T: 9 µm	625 °C, over night;	Al_2O_3; RT/duroid 6002 (RO6002); PI KAPTON	[31]
PI	Nozzle: 150 µm ~ 300 µm	T: 22 µm; 20 layers	< 280 °C for 5 hrs	Ag ground layers	[30]
C; cured at 115 °C for 5 min	PA; T_s = 75 ºC; S = 2 mm/s; Q_s = 40 sccm; Q_a = 900 sccm; Q_e = 1000 sccm	T: 6.5 µm; 1 layer	−0.12 V for 10 s	Alumina	[28]
PI; cured at 120 °C for 20 min	PA; T_s = 70 ºC; S = 3 mm/s; Q_s = 150 sccm; Q_a = 1270 sccm; Q_e = 1300 sccm	T: 2.7 µm; 1 layer	−0.12 V for 10 s	Alumina	[28]
NOA 81; η= 300 cP	PA; Nozzle: 200 µm; S = 1.5 mm/s; Q_s = 40 sccm; Q_a = 1395 sccm; Q_e = 1365 sccm	W: 96.75 µm; T: 26.06 µm		Alumina	[45]
Pt nano ink	PA; Nozzle: 150 µm; T_s = 100 ºC; S = 100 mm/s; Q_s = 20 sccm; Q_a = 10 sccm	W: 30 µm	500–750 ºC for 2 hrs	Ceramic Alumina, PI	[90]
PEDOT:PSS-based ink; 1.3 w%; η= 10 ~ 20 cP	UA; Nozzle: 300 µm; T_s = 40, 80 ºC; S = 7, 10 mm/s; Q_s = 40, 50 sccm; Q_a= 40 sccm	Glass: W: 100 µm; 25, 50, 75 layers; SLA: W: 100, 500, 700, 800 µm; 40 layers	150 ºC for 1 hr	Glass, SLA substrate	[83]
Ti3C2TX ink	PA; Nozzle: 750 µm; S = 1 ~ 2 mm/s; Q_s = 800 ~ 1000 sccm; Q_a = 650 sccm; Q_e = 500 sccm	W: 150 ± 2 µm; 1 layer; W: 216 ± 3 µm; 10 layer	60 °C for 30 min	PET, Al_2O_3	[91]
PEDOT:PSS; pH 5 ~ 8 0.6 ~ 1.2 wt%; η = 5 ~ 10 cP	UA; Nozzle: 250 µm; S = 10 mm/s; Q_s = 60 sccm; Q_a = 30 sccm;	W: 27 µm;	120 °C for 0.5 hr	Glass	[9]
PEDOT:PSS; *p*-type; 1 ~ 1.3 wt%;	UA: Nozzle: 300 µm; T_s = 80 °C; S = 2 mm/s; Q_s = 150 sccm; Q_a = 50 sccm;	W: ~ 80 µm; T: ~ 3 µm; 10 layers	130 °C for 2 hrs	PI, Glass	[11]
PEDOT:PSS; 10 wt% EG added	Nozzle: 150 µm; T_s = 60 °C; S = 0.5 mm/s; Q_s = 35 sccm; Q_a = 25 sccm;	~ 300 × 300 μm^2; Thick film		Ion Gel	[92]
PEDOT:PSS; 6 wt% EG added	Nozzle: 100 µm; T_s = 60 °C; Q_s = 17 sccm; Q_a = 12 sccm;	W: ~ 30 µm;		Ion Gel	[93]

PEDOT:PSS; Diameter: < 20 nm; 8 % w/v; η = 5 cP;	UA; Current: 512 mA; T_s = 60 °C; Nozzle: 200 µm; S = 1 mm/s; Q_s = 60 sccm; Q_a = 30 sccm;	W: ~ 185 µm; T: 0.4 µm;	120 °C for 1 hr	PI	[14]
POWs; UV curing varnish materials	PA; Nozzle: 300 µm; T_s = 45 ~ 60 ºC; S = 50 mm/s; Q_s = 60 sccm; Q_a - Q_e = 60 sccm	W: 328 µm; G: 20 µm; T/H: 66 µm;		PMMA, PVC, PI foil	[94]
POWs; UV curing varnish materials	PA; Nozzle: 200 µm	W: 290 µm; T: 50 µm		Si-based polymer	[95]

PI Ink;	PA; T_s = 70 °C; S = 3 mm/s; Q_s = 150 sccm; Q_a = 1270 sccm; Q_e = 1300 sccm;	T: 2.7 ± 2 µm;	120 °C for 20 min	Alumina	[45]
PI ink;	PA; Nozzle: 300 µm; T_s = 100 ºC; S = 1 mm/s; Q_s= 90 sccm; Q_a= 55 sccm	T: 31.909 µm; 39 layers	200 ºC for a 2-min	MoCu	[96]
Graphene/Ag NP Ink; Graphene NF < 200 nm;	UA; Volt: 42 V; Q_s = 50 sccm; Q_a = 20 sccm;	W: 40 ± 5 µm; T: 1.15 ± 0.03 µm;	250 °C for 30 min	PI	[12]
Graphene Ink; Graphene NF < 200 nm;	UA; Volt: 48 V; Q_s = 50 sccm; Q_a = 40 sccm;	W: 45 ± 5 µm; T: 0.06 ± 0.03 µm;	250 °C for 30 min	PI	[12]
Graphene Ink; Size: 50 ~ 200 nm; 3.5 mg/ml; η = 3.6 cP;	UA; P: 48 W; Nozzle: 100 µm; T_s = 65 °C; S = 1 mm/s; Q_s = 50 sccm; Q_a = 20 sccm;	W: ~ 50 µm;	100 °C for 10 min 200 °C for 30 min	SiO_2/Si, PI, Al_2O_3;	[97]

C-based conductive ink	PA; Nozzle: 300 µm	T: 4.36 µm; 20 layers		Si, Acrylic elastomers (Sylgard 184, Elastosil P7670, and 3M VHB 4910)	[98]
Carbon-based conductive ink;	PA; Nozzle: 300 µm	H: 25 µm; full width at half max height		PDMS; Glass	[98]
Ag NP (UTDots UTDAg PA); 40-60 wt%	PA; T_s = 70 ºC	W: 500 µm (100% surface printable) W: 280 µm (round 45% surface printable)	220 °C for 30 min	Fluorocarbon, Nylon fibre, PI	[99]

Ag NP, Ag NF(nanoflakes), Ag NW (nanowires)	Volt: -2 V; Ts = 80 oC	W: 500 µm		SiO_2	[100]
CNT Ink; 1300 µm	Ts = 150 ºC	W: 1300 µm		PLC coated with GelMA	[101]

Table S2: Semi-conductive inks applications

Ink Properties	Printing	Resolution	Post-processing	Substrate	Ref.
MWCNT + Water Ink: Dia: 110 ~ 170 nm;	PA: Nozzle: 300 µm; T_s = 80 °C; S = 2 mm/s; Q_s = 150 sccm; Q_a = 600 sccm; Q_e = 550 sccm;	W: ~ 100 µm; T: ~ 3 µm; 10 layers	130 °C for 2 hrs	PI, Glass	[11]
CNT Ink; Nink-1000; pH: 5 ~ 9; 2 g/L; η = ~ 3 cP;	UA; Volt: 40 V; T_s = 50 °C; S = 10 mm/s; No sheath flow; Q_a = 10 sccm;	Large area; T: 0.018 µm;	100 °C for 5 min	SU-8;	[102]
CNT Ink; Nink-1000; pH: 5 ~ 9; 2 g/L; η = ~ 3 cP;	PA; Nozzle: 200 µm; T_s = 45 °C; S = 3.5 mm/s; Q_s = 65 sccm; Q_a = 750 sccm; Q_e = 800 sccm;	W: 60 µm; T: 6.5 µm;	75 °C for 30 min	Glass	[13]
CNT Ink; Nink-1000; pH: 5 ~ 9; 2 g/L; η = ~ 3 cP;	PA; Nozzle: 200 µm; T_s = 40 °C; S = 2 mm/s; Q_s = 50 sccm; Q_a = 670 sccm; Q_e = 580 sccm;	W: 60 µm; T: 6.5 µm;	75 °C for 30 min	Glass	
CNT Ink;	PA; Nozzle: 300 µm; Q_s = 50 sccm; Q_a = 25 sccm;	W: 80 µm;	N/A	PI;	[16]
MWCNT Ink; in NMP; 1 wt%;	UA; Nozzle: 300 µm; T_s = 60 °C; S = 8 mm/s; Q_s = 90 sccm; Q_a = 50 sccm;	T: 20 µm; 15 layers	120 °C for 60 min 220 °C for 60 min	Glass	[103]
CNT Ink; 0.05 mg/mL; in Toluene;	UA; Current: 330 mA; Nozzle: 150 µm; T_s = RT; S = 8 mm/s; Q_s = 25 sccm; Q_a = 38 sccm;		70 ~ 80 °C for < 1 min	PI;	[23]
CNT Ink; 0.02 mg/mL; in Toluene;	UA; Current: 330 mA; Nozzle: 150 µm; T_s = RT; S = 2 mm/s; Q_s = 40 sccm; Q_a = 23 sccm;		70 ~ 80 °C for < 1 min	Paper;	[23]
SWCNT Ink; 0.01 mg/mL in Toluene, ;	UA; Nozzle: 150 µm; T_s = 60 °C; S = 2 mm/s; Q_s = 40 sccm; Q_a = 23 sccm;	W: 50 µm;	150 °C for 30 min	SiO_2/Si; PI;	[17]
(6,5) SWCNT Ink, in Toluene & Terpineol; 1.8 mg/L;	UA; Current: 520 mA; Nozzle: 200 µm; T_s = 100 °C; Q_s = 30 sccm; Q_a = 14 sccm;	W: ~ 60 µm; T: 0.03 µm (6.3 mg/L); 4 layer		Glass	[104,105]
SWCNT Ink in water; Carboxyl functionalized,	UA; Current: 600 mA; Nozzle: 150 ~ 300 µm; T_s = 25 ~ 80 °C; S = 10 ~ 50 mm/s; Q_s = 10 ~ 150 sccm; Q_a = 25 ~ 40 sccm;	W: 16.4 µm; T: 3.49 µm; 1 layer;		PI;	[106]

SWCNT Ink; in water with SDBS; 0.2 wt%;	UA; Current: 600 mA; Nozzle: 150 µm; T_s = 40 °C; S = 10 mm/s; Q_s = 10 ~ 40 sccm; Q_a = 20 ~ 35 sccm;	W: ~ 30 µm; T: 0.45 µm; 10 layers;	65 °C for 2 hrs	Ag tracks on PI;	[107]

In_2O_3 Ink; Solvent: Acetonitrile	Nozzle: 150 µm; T_s = 60 °C; S = 2 mm/s; Q_s = 40 sccm; Q_a = 10 sccm;	W: 10 µm; T: 0.03 µm;	400 °C for 1 hr	Si/SiO_2	[92]
NiO Ink; for thermistor; 4.76 wt%;	UA; Nozzle: 100 µm;	∅ = 100 µm;	200 °C for 1 hr	Al_2O_3 coated WC	[108]
P3HT Ink; 1 mg/mL; Organic semiconductor;	Nozzle: 150 µm; Q_s = 32 sccm; Q_a = 12 sccm;	W: ~ 30 µm; T: 0.03 µm;		Si/SiO_2	[93]
Clevios P JET N V2 in Ethylene glycol; η= 5 cP	UA; Current: 0.5 mA; Nozzle: 200 µm; T: 60 ºC; S = 1 mm/s; Q_s = 60 sccm; Q_a = 30 sccm	W: 200 µm	30 W plasma-oxygen for 2 mins 120 ◦C for 1 hr	PI kapton	[78]
CNT ink; 0.1 mg/mL	UA; Current: 410 mA; Nozzle: 150 µm; T: 23 ºC; S = 8 mm/s; Q_s = 30 sccm	2 layers		SiO2/Si	[109]

Table S3: Dielectric inks applications

Ink Properties	**Printing**	**Resolution**	**Post-processing**	**Substrate**	**Ref.**
RuO_2 (ESL-3111)	UA	T: 9 µm	625 °C, over night;	Al_2O_3; RT/duroid 6002 (RO6002); PI KAPTON	[31]
PI	Nozzle: 150 µm ~ 300 µm	T: 22 µm; 20 layers	< 280 °C for 5 hrs	Ag ground layers	[30]
C; cured at 115 °C for 5 min	PA; T_s = 75 ºC; S = 2 mm/s; Q_s = 40 sccm; Q_a = 900 sccm; Q_e = 1000 sccm	T: 6.5 µm; 1 layer	−0.12 V for 10 s	Alumina	[28]
PI; cured at 120 °C for 20 min	PA; T_s = 70 ºC; S = 3 mm/s; Q_s = 150 sccm; Q_a = 1270 sccm; Q_e = 1300 sccm	T: 2.7 µm; 1 layer	−0.12 V for 10 s	Alumina	[28]
NOA 81; η= 300 cP	PA; Nozzle: 200 µm; S = 1.5 mm/s; Q_s = 40 sccm; Q_a = 1395 sccm; Q_e = 1365 sccm	W: 96.75 µm; T: 26.06 µm		Alumina	[45]
Pt nano ink	PA; Nozzle: 150 µm; T_s = 100 ºC; S = 100 mm/s; Q_s = 20 sccm; Q_a = 10 sccm	W: 30 µm	500–750 ºC for 2 hrs	Ceramic Alumina, PI	[90]
PEDOT:PSS-based ink; 1.3 w%; η= 10 ~ 20 cP	UA; Nozzle: 300 µm; T_s = 40, 80 ºC; S = 7, 10 mm/s; Q_s = 40, 50 sccm; Q_a= 40 sccm	Glass: W: 100 µm; 25, 50, 75 layers; SLA: W: 100, 500, 700, 800 µm; 40 layers	150 ºC for 1 hr	Glass, SLA substrate	[83]
Ti3C2TX ink	PA; Nozzle: 750 µm; S = 1 ~ 2 mm/s; Q_s = 800 ~ 1000 sccm; Q_a = 650 sccm; Q_e = 500 sccm	W: 150 ± 2 µm; 1 layer; W: 216 ± 3 µm; 10 layer	60 °C for 30 min	PET, Al_2O_3	[91]
PEDOT:PSS; pH 5 ~ 8 0.6 ~ 1.2 wt%; η = 5 ~ 10 cP	UA; Nozzle: 250 µm; S = 10 mm/s; Q_s = 60 sccm; Q_a = 30 sccm;	W: 27 µm;	120 °C for 0.5 hr	Glass	[9]
PEDOT:PSS; *p*-type; 1 ~ 1.3 wt%;	UA: Nozzle: 300 µm; T_s = 80 °C; S = 2 mm/s; Q_s = 150 sccm; Q_a = 50 sccm;	W: ~ 80 µm; T: ~ 3 µm; 10 layers	130 °C for 2 hrs	PI, Glass	[11]
PEDOT:PSS; 10 wt% EG added	Nozzle: 150 µm; T_s = 60 °C; S = 0.5 mm/s; Q_s = 35 sccm; Q_a = 25 sccm;	~ 300 × 300 µm^2; Thick film		Ion Gel	[92]

PEDOT:PSS; 6 wt% EG added	Nozzle: 100 µm; T_s = 60 °C; Q_s = 17 sccm; Q_a = 12 sccm;	W: ~ 30 µm;		Ion Gel	[93]
PEDOT:PSS; Diameter: < 20 nm; 8 % w/v; η = 5 cP;	UA; Current: 512 mA; T_s = 60 °C; Nozzle: 200 µm; S = 1 mm/s; Q_s = 60 sccm; Q_a = 30 sccm;	W: ~ 185 µm; T: 0.4 µm;	120 °C for 1 hr	PI	[14]
POWs; UV curing varnish materials	PA; Nozzle: 300 µm; T_s = 45 ~ 60 ºC; S = 50 mm/s; Q_s = 60 sccm; Q_a - Q_e = 60 sccm	W: 328 µm; G: 20 µm; T/H: 66 µm;		PMMA, PVC, PI foil	[94]
POWs; UV curing varnish materials	PA; Nozzle: 200 µm	W: 290 µm; T: 50 µm		Si-based polymer	[95]
PI Ink;	PA; T_s = 70 °C; S = 3 mm/s; Q_s = 150 sccm; Q_a = 1270 sccm; Q_e = 1300 sccm;	T: 2.7 ± 2 µm;	120 °C for 20 min	Alumina	[45]
PI ink;	PA; Nozzle: 300 µm; T_s = 100 ºC; S = 1 mm/s; Q_s= 90 sccm; Q_a= 55 sccm	T: 31.909 µm; 39 layers	200 ºC for a 2-min	MoCu	[96]
BaTiO3 ink; 20 wt%; 50 nm	UA; Nozzle: 300 µm; T_s: 100 ºC; S = 1.5 mm/s; Q_s = 35 sccm; Q_a = 25 sccm	T: 2.754 µm; 2 layers	200 ºC for a 2-min	MoCu	[96]
Dielectric PI Ink	PA; Nozzle: 300 µm; T_s = 25 ºC; S = 3 mm/s; Q_s = 120 sccm; Q_a= 750 sccm; Q_e = 725 sccm	W: 67.5 µm	UV rays-Flyby	Glass	[80]
PolyVinyl Alcohol (PVA); > 4.5 w%; η= 8.8 ~ 9 cP	UA; Current: 627 mA; Nozzle: 200 µm; T_s = 45 ºC; S = 1 mm/s; Q_s = 5 sccm; Q_a= 50 sccm	5250 µm × 190 µm line; T: 3.5 µm; 1 layer 5255 µm × 4060 µm square; T: 5.5 µm; 2 layers	80 ~ 90 ºC	PI kapton, Si	[110]
MWCNT + Water Ink: Dia: 110 ~ 170 nm;	PA: Nozzle: 300 µm; T_s = 80 °C; S = 2 mm/s; Q_s = 150 sccm; Q_a = 600 sccm; Q_e = 550 sccm;	W: ~ 100 µm; T: ~ 3 µm; 10 layers	130 °C for 2 hrs	PI, Glass	[11]
CNT Ink; Nink-1000; pH: 5 ~ 9; 2 g/L; η = ~ 3 cP;	UA; Volt: 40 V; T_s = 50 °C; S = 10 mm/s; No sheath flow; Q_a = 10 sccm;	Large area; T: 0.018 µm;	100 °C for 5 min	SU-8;	[102]
CNT Ink; Nink-1000; pH: 5 ~ 9; 2 g/L; η = ~ 3 cP;	PA; Nozzle: 200 µm; T_s = 45 °C; S = 3.5 mm/s; Q_s = 65 sccm; Q_a = 750 sccm; Q_e = 800 sccm;	W: 60 µm; T: 6.5 µm;	75 °C for 30 min	Glass	[13]

CNT Ink; Nink-1000; pH: 5 ~ 9; 2 g/L; η = ~ 3 cP;	PA; Nozzle: 200 µm; T_s = 40 °C; S = 2 mm/s; Q_s = 50 sccm; Q_a = 670 sccm; Q_e = 580 sccm;	W: 60 µm; T: 6.5 µm;	75 °C for 30 min	Glass	
CNT Ink;	PA; Nozzle: 300 µm; Q_s = 50 sccm; Q_a = 25 sccm;	W: 80 µm;	N/A	PI;	[16]
MWCNT Ink; in NMP; 1 wt%;	UA; Nozzle: 300 µm; T_s = 60 °C; S = 8 mm/s; Q_s = 90 sccm; Q_a = 50 sccm;	T: 20 µm; 15 layers	120 °C for 60 min 220 °C for 60 min	Glass	[103]
CNT Ink; 0.05 mg/mL; in Toluene;	UA; Current: 330 mA; Nozzle: 150 µm; T_s = RT; S = 8 mm/s; Q_s = 25 sccm; Q_a = 38 sccm;		70 ~ 80 °C for < 1 min	PI;	[23]
CNT Ink; 0.02 mg/mL; in Toluene;	UA; Current: 330 mA; Nozzle: 150 µm; T_s = RT; S = 2 mm/s; Q_s = 40 sccm; Q_a = 23 sccm;		70 ~ 80 °C for < 1 min	Paper;	[23]
SWCNT Ink; 0.01 mg/mL in Toluene, ;	UA; Nozzle: 150 µm; T_s = 60 °C; S = 2 mm/s; Q_s = 40 sccm; Q_a = 23 sccm;	W: 50 µm;	150 °C for 30 min	SiO_2/Si; PI;	[17]
(6,5) SWCNT Ink, in Toluene & Terpineol; 1.8 mg/L;	UA; Current: 520 mA; Nozzle: 200 µm; T_s = 100 °C; Q_s = 30 sccm; Q_a = 14 sccm;	W: ~ 60 µm; T: 0.03 µm (6.3 mg/L); 4 layer		Glass	[104,105]
SWCNT Ink in water; Carboxyl functionalized,	UA; Current: 600 mA; Nozzle: 150 ~ 300 µm; T_s = 25 ~ 80 °C; S = 10 ~ 50 mm/s; Q_s = 10 ~ 150 sccm; Q_a = 25 ~ 40 sccm;	W: 16.4 µm; T: 3.49 µm; 1 layer;		PI;	[106]
SWCNT Ink; in water with SDBS; 0.2 wt%;	UA; Current: 600 mA; Nozzle: 150 µm; T_s = 40 °C; S = 10 mm/s; Q_s = 10 ~ 40 sccm; Q_a = 20 ~ 35 sccm;	W: ~ 30 µm; T: 0.45 µm; 10 layers;	65 °C for 2 hrs	Ag tracks on PI;	[107]
Graphene/Ag NP Ink; Graphene NF < 200 nm;	UA; Volt: 42 V; Q_s = 50 sccm; Q_a = 20 sccm;	W: 40 ± 5 µm; T: 1.15 ± 0.03 µm;	250 °C for 30 min	PI	[12]
Graphene Ink; Graphene NF < 200 nm;	UA; Volt: 48 V; Q_s = 50 sccm; Q_a = 40 sccm;	W: 45 ± 5 µm; T: 0.06 ± 0.03 µm;	250 °C for 30 min	PI	[12]
Graphene Ink; Size: 50 ~ 200 nm; 3.5 mg/ml; η = 3.6 cP;	UA; P: 48 W; Nozzle: 100 µm; T_s = 65 °C; S = 1 mm/s; Q_s = 50 sccm; Q_a = 20 sccm;	W: ~ 50 µm;	100 °C for 10 min 200 °C for 30 min	SiO_2/Si, PI, Al_2O_3;	[97]

In_2O_3 Ink; Solvent: Acetonitrile	Nozzle: 150 µm; T_s = 60 °C; S = 2 mm/s; Q_s = 40 sccm; Q_a = 10 sccm;	W: 10 µm; T: 0.03 µm;	400 °C for 1 hr	Si/SiO_2	[92]
NiO Ink; for thermistor; 4.76 wt%;	UA; Nozzle: 100 µm;	Ø = 100 µm;	200 °C for 1 hr	Al_2O_3 coated WC	[108]
P3HT Ink; 1 mg/mL; Organic semiconductor;	Nozzle: 150 µm; Q_s = 32 sccm; Q_a = 12 sccm;	W: ~ 30 µm; T: 0.03 µm;		Si/SiO_2	[93]
SnO_2 NP Ink; in butanols, 7 ~ 20 nm; 0.1 ~ 0.25 wt%; $\eta \leq 3.5$ cP;	Q_s = 20 sccm; Q_a = 30 sccm;	W: 100 ~ 400 µm; T: 1 ~ 3 µm;	350 °C for 2 hrs	Si;	[111]
WSe_2 Flakes Ink; 0.1 mg/mL;	UA; Nozzle: 300 µm; Q_s = 50 sccm; Q_a = 35 sccm;	W: 80 µm; T: 0.3 µm; 30 layers;		PI;	[16]
ZnO Ink; 35 ~ 45 nm;	PA; T_s = 60 °C; S = 2 mm/s; Q_s = 100 sccm; Q_g = 850 sccm; Q_e = 800 sccm;	T: 2.9 µm; Large area;	150 °C for 30 min	PET;	[19,112]
ZnO Ink;	T_s = 39 °C; S = 3 mm/s	W: 75 µm; T: 0.4 µm; 6 layers;	90 °C for 30 min 200 °C for 1 hr	PI	[113]
IGZO (Indium/gallium-codoped ZnO); Zn:In:Ga = 98:1:1;	T_s = 39 °C; S = 3 mm/s;		90 °C for 30 min 400 °C for 1 hr	PI	[113]
SU-8;	UA; Nozzle: 250 µm; S = 10 mm/s; Q_s = 40 sccm; Q_a = 20 sccm;	W: 27 µm;	80 °C for 5 min	Glass	[9]
SU-8 (2002); In cyclopentanone, η = 8.4 cP;	UA; T_s = 60 °C; S = 2 mm/s; Q_s = 40 sccm; Q_a = 20 sccm;	W: 70 µm; T: 30 µm; 5 layers;	150 °C for 5 min UV cure for 2 min	Copper plane	[21]
SU-8 (2002); In cyclopentanone, η = 8.4 cP;	UA; Volt: 30 V; T_s = 50 °C; S = 3 mm/s; Q_s = 40 sccm; Q_a = 20 sccm;	Large area; T: 3.9 µm;	100 °C for 5 min UV cure for 30 sec	Glass;	[102]

SU-8 (2002); In cyclopentanone; , η = 2.5 cP;	UA; Nozzle: 300 µm; T_s = 60 °C; S = 2 ~ 5 mm/s; Q_s = 40 ~ 60 sccm; Q_a = 20 ~ 30 sccm;	W: 70 ~ 150 µm; T: 30 µm; 5 layers;	150 °C for 5 min UV cure for 2 min	FR4;	[19]
PI Ink; 5 wt%;	PA; Nozzle: 300 µm; T_s = 110 °C; Q_s = 100 sccm; Q_a = 25 sccm;	W: 70 µm; T: 1 µm;	180 °C for 40 min 300 °C for 30 min	Copper sheet	[10]
UV Supraflex Varnishes (J+S); η = 40 cP	PA; Nozzle: 250 µm; Q_s = 60 sccm; Q_a = 60 sccm;	W: 300 µm; T: 45 µm;		PMMA	[114,115]
PU + DMF Ink; 5 wt%;	PA: Nozzle: 300 µm; T_s = 80 °C; S = 2 mm/s; Q_s = 100 sccm; Q_a = 1000 sccm; Q_e = 800 sccm;	W: ~ 100 µm; T: ~ 5 µm; 10 layers	100 °C for 12 hrs	PI, Glass	[11]
PU + DMF Ink; 20 wt%;	PA: Nozzle: 250 µm; Q_s = 140 sccm; Q_a = 1000 sccm; Q_e = 900 sccm;	W: 250 µm; T: 50 µm;	80 °C for 30 min	Glass	[15]
PI + NMP Ink;	PA: Nozzle: 300 µm; T_s = 80 °C; S = 2 mm/s; Q_s = 100 sccm; Q_a = 1200 sccm; Q_e = 1000 sccm;	W: ~ 100 µm; T: ~ 10 µm; 10 layers	130 °C for 12 hrs	PI, Glass	[11]
PI + NMP Ink;	PA; Nozzle: 250 µm; Q_s = 140 sccm; Q_a = 1100 sccm; Q_e = 900 sccm;	W: ~ 25 µm	80 °C for 2 hrs 130 °C for 6 hrs	Teflon, Al foil, Nylon;	[15]
PI Ink; PAA in NMP;	PA; Q_a = 20 ~ 160 sccm;	W: 200 µm; T: 30 µm; 3 layers;	60 °C for 2 hrs 130 °C for 12 hrs	Glass	[116]
PAA in NMP & Xylene; 10 wt%;	PA; Nozzle: 300 µm; T_s = 60 °C; S = 8 mm/s; Q_s = 90 sccm; Q_a = 50 sccm;	T: 20 µm; 15 layers	120 °C for 60 min 220 °C for 60 min	Glass	[103]
PVDF + NMP Ink; 5 wt%;	PA: Nozzle: 300 µm; T_s = 80 °C; S = 2 mm/s; Q_s = 100 sccm; Q_a = 1000 sccm; Q_e = 800 sccm;	W: ~ 100 µm; T: ~ 5 µm; 10 layers	100 °C for 12 hrs	PI, Glass	[11]
PVDF-TrFE Ink; 4 wt%;	PA; Nozzle: 250 µm; Q_s = 140 sccm; Q_a = 1100 sccm; Q_a = 950 sccm;	G: 600 µm;	130 °C for 2 hrs	PI	[15]

Ion Gel Ink: 9% [EMI][TFSI] + 1% PS-PMMA-PS + 90% EA (wt %)	Nozzle: 150 µm; T_s = 60 °C; S = 2 mm/s; Q_s = 25 sccm; Q_a = 12 sccm;	~ 800 × 800 µm^2; Thick film		Si/SiO_2 & In_2O_3;	[92]
Ion Gel Ink: 9% [EMI][TFSI] + 1% PS-PMMA-PS + 90% EA (wt %)	Nozzle: 150 µm; Q_s = 28 sccm; Q_a = 8 sccm;			Si/SiO_2 & P3HT	[93]
Norland NEA 121; UV Curable; η = 300 cP;	PA; Nozzle: 300 µm; S = 1 mm/s; Q_s = 50 sccm; Q_a = 1200 sccm; Q_e = 1150 sccm;	W: ~ 400 µm; T: 0.05 µm;	125 °C for 10 min	Ag tracks on PI	[14]
Norland NEA 121; UV Curable; η = 300 cP;	PA; Nozzle: 300 µm; S = 1 mm/s; Q_s = 50 sccm; Q_a = 970 sccm; Q_e = 920 sccm;	W: 200 µm;	365 nm UV LED	Glass; FR4	[18]
Norland NOA 81; UV Curable; η = 300 cP;	PA; Nozzle: 200 µm; T_s = RT; S = 0.75 mm/s; Q_s = 80 sccm; Q_a = 1360 sccm; Q_e = 1400 sccm;	W: 60 µm; T: 25 µm;	UV LED; 5% power at 17200 mW·cm^{-2}	Glass	[13]
Norland NOA 81; UV Curable; η = 300 cP;	PA; Nozzle: 200 µm; T_s = RT; S = 1.5 mm/s; Q_s = 40 sccm; Q_a = 1395 sccm; Q_e = 1365 sccm;	W: 60 µm; T: 25 µm;	UV LED; 5% power at 17200 mW·cm^{-2}	Glass	
Silicone – RTV;	PA; S = 5 mm/s; Q_s = 600 sccm; Q_a = 2400/2800 sccm; Q_e = 1800/2200 sccm;	T: 30 µm; Large area; 2 layers;	140 °C for 3 min	Silicone;	[89]
UV curable PDMS;	PA; Nozzle: 3 × 0.25 mm^2; S = 0.9 mm/s; Q_s = 400 sccm; Q_a = 3500 sccm; Q_a = 2600 sccm;	W: 3 mm; T: 1.6 µm;	365 nm UV LED 155 °C for 15 min	Glass;	[117]
UV curable PDMS;	PA; Nozzle: 3 × 0.25 mm^2; S = 2 mm/s; Q_s = 400 sccm; Q_a = 4000 sccm; Q_e = 2600 ~ 3000 sccm;	W: 350 µm; T: 3.5 µm;	365 nm UV LED 70 °C for 20 min	Glass;	[118]
xdi-dcs Ink (PVP + pMSSQ); in *n*-butanol;	UA; Nozzle: 150 µm; T_s = 30 °C; S = 5 ~ 10 mm/s; Q_s = 20 sccm; Q_a = 28 sccm;	T: 1.6 µm;	80 °C for 10 min 140 °C for 30 min	SiO_2/Si; PI;	[17]

h-BN Ink; > 1 μm; 2 mg/mL; in DI water;	UA; Current: 390 mA; Nozzle: 200 μm; T_s = 80 °C; S = 2 mm/s; Q_s = 25 sccm; Q_a = 40 sccm;	T: 1 μm; 1 layer;	80 °C for 20 min	CNT & Ag tracks on PI;	[23]
Bi2Te2.7Se0.3 Ink 15 wt%;	PA; Nozzle: 150 μm; T_s = 70 ~ 75 °C; S = ~ 5.5 mm/s; Q_s = 12 sccm; Q_a = 50 sccm;	W: ~ 120 μm; T: ~ 65 μm;	950 J ms-1 pulsed light sintering	Paper, PI, glass	[119]
Bi2Te3/Sb2Te3 Ink 130 ~ 540 nm	PA: Nozzle: 300 μm; T_s = 80 °C; S = 2 mm/s; Q_s = 150 sccm; Q_a = 600 sccm; Q_e = 550 sccm;	W: ~ 100 μm; T: ~ 5 μm; 10 layers	130 °C for 2 hrs	PI, Glass	[11]
CH3NH3I Ink (2 wt%) on PbI2 Ink (10 wt%); Perovskite film	UA; Nozzle: 150 μm; T_s = 70 °C; S = 30 mm/s; Q_s = 5 ~ 35 sccm; Q_a = 10 ~ 25 sccm;	W: 50 μm; G: 10 μm; T: ~ 0.35 μm;	100 °C for 80 min	PEDOT:PSS /ITO/Glass	[120]
PEO/ LiDFOB/ Al2O3 Solid Electrolyte Ink; η = ~ 10 cP;	UA; Solid Deposition Rate: 2×10-3 ~ 4× 10-3 g/min;	T: 40 ~ 50 μm; 60 layers;	Overnight dry at RT	LiFePO4 cathode tape	[121]
PEO/ LiTriflate /Al2O3 Solid Electrolyte Ink; η = ~ 10 cP;	UA; Solid Deposition Rate: 2×10-3 ~ 4× 10-3 g/min;	T: 200 ~ 300 μm; 60 layers;	Overnight dry at RT	LiFePO4 cathode tape	[121]
LiFePO4 Ink; for Battery Cathode, 23.9 wt%; η = 20 cP at 500s-1;	UA; Solid Deposition Rate: 20×10-3 g/min; T_s = 35 °C;	T: 100 ~ 170 μm; 80 layers; Large area;	35 °C for 4 hrs 90 °C for 16 hrs	Carbon coated Al	[122]
Lead Zirconate Titanate (PZT) Ink; Powder: 1.5 ~ 3.5 μm; Piezoelectric	Nozzle: 200 μm; S = 10 mm/s;	W: 20 ~ 100 μm; T: 32 μm; 2 layers	200 °C for 2 hrs	Si wafer	[123]
Light-emitting PPV- and spiro- copolymer Ink; 0.5 gL-1;	Nozzle: 200 μm; Shutter time: 1 s;	∅ = ~ 200 μm;		Glass	[124]
Solar Cell Metallization Ink; (glass, Ag, ZnO); η = ~ 65 cP at 30s-1;	Nozzle: 150 μm; T_s = 170 °C; Q_s = 100 sccm; Q_a = 25 sccm;	W: ~ 30 μm;		Si wafer;	[125]

Table S4: Biological inks applications

Ink Properties	Printing	Resolution	Post-processing	Substrate	Ref.
Peptide Ink; crystal in distilled water; 1 ~ 40 mg/mL;	UA; Volt: 25 V; Nozzle: 150 µm; T_s = RT; S = 5 mm/s; Q_s = 43 sccm; Q_a = 30 sccm;		Drop casting of 7% MoS2 solution	Glass	[126]
Ferro/ferri-cyanide solution; 5 mM;	UA; Current: 500 mA; Nozzle: 200 µm; T_s = RT; S = 2 mm/s; Q_s = 60 sccm; Q_a = 40 sccm;				
Glucose Oxidase in acetate buffer; pH = 5; 300 U/mL;	UA; Current: 500 mA; Nozzle: 200 µm; T_s = RT; S = 2 mm/s; Q_s = 60 sccm; Q_a = 40 sccm;				
Cyclopentanon:aryl epoxy resin; 92 wt%; η= 11 cP	UA; Current: 500 mA; Nozzle: 200 µm; T: 75 ºC; S = 3 mm/s; Q_s = 110 sccm; Q_a = 25 sccm	W: 44.6 µm; 5 x 5 unite; 1 ~ 100 layers	O2 and CF4 RIE at 1200 W		[127]
polymer brush films (POEGMA)	UA; Current: 320 mA; Q_s = 160 sccm; Q_a = 16 sccm		120 ◦C for 2 hrs	Glass	[128]
Collagen Type I; 10 w%; 6 mg/mL	UA; Nozzle: 150 µm; T: 30 oC; Q_s = 40 sccm; Q_a = 19 sccm	⌀: 84.1±4.6 µm; 50 layers	254 nm UV-light for 1 h	Cellulose nanocrystals	[129]
CleviosTM PH1000; η= 15 ~ 50 cP	UA; Current: 0.65 mA; Nozzle: 100 µm; S = 1.17 ~ 1.5 mm/s; Q_s = 30 ~ 40 sccm; Q_a = 20 ~ 25 sccm	W: 30 ~ 50 µm		Glass	[130]
Polymer brush films (POEGMA);	UA; Current: 320 mA; Nozzle: 100 µm; S = 0.5 mm/s; Q_s = 16 sccm; Q_a = 16 sccm		120 ◦C for 2 hrs	Glass	[128]
Glucose;	UA; Current 500 mA; S = 2 mm/s; Q_s = 60 sccm; Q_a = 40 sccm;			Alumina	[45]
Biological Inks in PBS (Cy5 conjugated BSA, Streptavidin, Anti-CEA); 0.2 mg/mL;	UA; Nozzle: 100 µm; Current: 320 mA; T_s = 30 °C; S = 0.5 mm/s; Q_s = 16 sccm; Q_a = 16 sccm;	W: 100 µm; ϕ: 22 µm;	30 °C for overnight Incubation for 1 hr	POEGMA coated glass	[22]
Protein Inks in PBS, (DNA: 0.01 ~ 0.1 mg/mL; BSA: 0.01 ~ 1 mg/mL, HRP: 0.1 mg/mL);	Nozzle: 100 µm; S = 0.5 ~ 1 mm/s; T_s = 50 → 120 °C (HRP);	W: 17 µm (BSA); W: 10.5 µm (DNA); ϕ: 9 µm (BSA);		Unmodified & nitrocellulose coated Glass	[131]

Gelatin Aqueous Solution; 1 ~ 6 % (w/v);	UA; Current: 680 mA; Nozzle: 100 ~ 300 μm; T_s = 35 ~ 115 °C; S = 1 ~ 10 mm/s; Q_s = 50 ~ 250 sccm; Q_a = 25 ~ 50 sccm;	W: 30 μm; G: 100 μm; T: 2.2 μm;		Glass	[132]
Poly-L-lysine aqueous solution; 0.1 % (w/v);	UA; Current: 680 mA; Nozzle: 100 ~ 300 μm; T_s = 35 ~ 115 °C; S = 1 ~ 10 mm/s; Q_s = 50 ~ 250 sccm; Q_a = 25 ~ 50 sccm;	W: ~ 20 μm; G: 100 μm;	UV sterilization for 30 min, NG108-15 cell seeding;	Glass	[132]

Table S5: Combined inks applications

Ink 1 Properties	Ink 1 Printing	Ink 2 Properties	Ink 2 Printing	Resolution	Post-processing	Substrate	Ref.
Sb2Te3 + MWCNTs	PA; Q_s = 150 sccm; Q_a = 50 ~ 10 sccm;	PEDOT:PSS	UA; Q_s = 150 sccm; Q_a = 50 sccm;	W: 200 µm;	130 °C for 30 min 80 °C for 2 hrs	Polyimide	[133]
Component A (RTV silicone)	PA; Q_s = 600 sccm; Q_a = 468 sccm; T_a = 119 °C;	Component B (RTV silicone)	PA; Q_s = 600 sccm; Q_a = 468 sccm; T_a = 150 °C;	Large area; 20 mg/min;	140 °C for 3 min	Silicone	[134]
PDMS KER-4690-A	PA; Q_s = 400 sccm; Q_a = 900 sccm; T_a = 32.5 °C;	PDMS KER-4690-B	PA; Q_s = 400 sccm; Q_a = 900 sccm; T_a = 40 °C;	T: 1.6 µm; 0.34 mg/min;	365 nm UV LED 155 °C for 15 min	Glass	[117]
PDMS KER-4690-A	PA; Q_s = 400 sccm; Q_a = 1000 sccm; T_a = 40 °C;	PDMS KER-4690-B	PA; Q_s = 400 sccm; Q_a = 1000 sccm; T_a = 45 °C;	T: 3.5 µm; 0.25 mg/min;	365 nm UV LED 70 °C for 20 min	Glass	[118]
MWCNT Ink; in NMP; 1 wt%;	UA; Q_s = 90 sccm; Q_a = 50 sccm;	PAA in NMP & Xylene; 10 wt%;	PA; Q_s = 90 sccm; Q_a = 50 sccm;	T: 20 µm; 15 layers	120 °C for 60 min 220 °C for 60 min	Glass	[103]
Ag NP Ink, in DI water; TPS 50.	UA; Q_a = 30 sccm;	PI Ink; in NMP &	PA; Q_a = 20 ~ 160 sccm;	W: ~ 120 µm; T: ~ 13 µm;	60 °C for 2 hrs 130 °C for 12 hrs	Glass	[116]
AgCl Ink (XA-3773); η= 19.5 cP	PA; Nozzle: 200 µm; T_s = 65 ºC; S = 2 mm/s; Q_s = 130 sccm; Q_a = 550 sccm; Q_e= 600 sccm	C Ink (EXP 2652-28)	PA; Nozzle: 200 µm; η= 300 cP; Ts = 75 ºC; S = 2 mm/s; Q_s = 40 sccm; Q_a = 900 sccm; Q_e = 1000 sccm	W: 51.8 µm; T: 2.71 µm W: 127.8 µm; T: 1.97 µm	115 °C for 15 min	Alumina	[45]
Ag NP; water-based flake ink HPS-108AE1	PA	PI Ink	PA	W: 250 µm ; T: 4 µm	Cured for 2 hrs	PTFE, PEEK, Pebax	[135]
Ag NP in Ethylene glycol; η= 15 cP; 75 nm	UA; Nozzle: 150 µm; Ts = 20 ~ 25 ºC; S = 0.5 mm/s; Q_s = 75 sccm; Q_a = 20 sccm	Ag NP; 20 ~ 25 oC; 90 nm	PA; Nozzle: 200 µm; T_s = 20 ~ 25 ºC; S = 5 mm/s; Q_s = 105 sccm; Q_a = 15 sccm	W: 19 ~ 20 µm ; T: 1.8 ~ 2 µm	200 ºC for 1 hr	Glass	[136]
Ag NP (Clariant Prelect TPS 50 G2) in 3 ml deionized water; η= 5 cP; 10 ~ 20 nm	UA; Nozzle: 150 µm; S = 1 mm/s; Q_s = 35 sccm; Q_a = 24 sccm	Cu Ink	UA; Nozzle: 150 µm; S = 1 mm/s; Q_s = 35 sccm; Q_a = 24 sccm	W: 30 µm ; G: 30 µm W: 65 µm ; G: 25 µm	160 ºC for 3 hrs	LCP	[137]
Graphite ink; 9.7 wt% graphite powder	PA; Q_s = 100 sccm; Q_a = 1175 sccm; Q_e = 1100 sccm	Ag NP ink (DOWA)	PA; Q_s = 30 sccm; Q_a = 1800 sccm; Q_e = 1770 sccm	W: 100 µm ; T: 10 µm		LCP	[138]

Dielectric PI	UA; Nozzle: 300 µm; S = 5 mm/s; Q_s = 60 sccm; Q_a = 30 sccm	Ag ink	PA; Nozzle: 150 µm; T_s = 42 ºC; S = 3 mm/s; Q_s = 50 sccm; Q_a = 1150 sccm; Q_e = 1100 sccm	W: 130 µm ; T: 100 µm W: 15 µm ; T: 10 µm	150 ºC for 5 mins Laser sinterin at 100 mW	PI	[139]

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