# Support Information

## Optimization of microstructure of conductive inks with high silver content by solvent volatilization modulation and application in flexible electronics

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## 1. Synthesis of precursors

Using the same steps and preparation process as for silver citrate, silver tartrate was prepared via an ion exchange reaction between sodium tartrate and silver nitrate. Specifically, 0.01 mol of sodium tartrate solution was reacted with 0.02 mol of silver nitrate solution. Similarly, silver oxalate was prepared via an ion exchange reaction between sodium oxalate and silver nitrate, following the same steps as for the preparation of silver citrate. Specifically, 0.01 mol of sodium oxalate solution was reacted with 0.02 mol of silver nitrate solution. Finally, using the same preparation method as described above, silver carbonate was prepared via an ion exchange reaction between anhydrous potassium carbonate and silver nitrate. Specifically, 0.01 mol of anhydrous potassium carbonate was reacted with 0.02 mol of silver nitrate solution to prepare silver carbonate. The reaction equation is as follows:

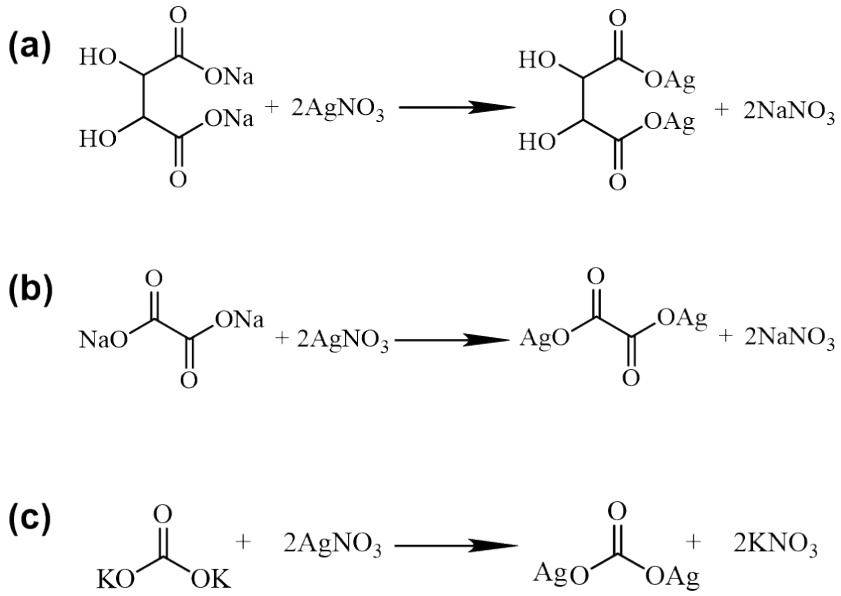


**Figure S1** Synthesis reaction equation for: (a)silver tartrate, (b)silver oxalate, and （c）silver carbonate

## 2. Substrate hydrophobicity angle before and after ozone treatment

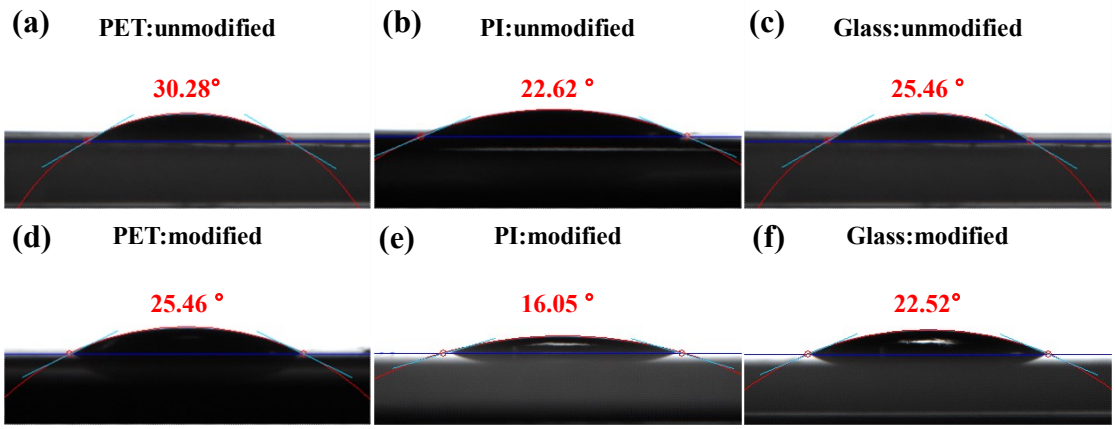


**Figure S2** Contact angles of ink on the substrates under UV-ozone treatment for 20 minutes:(a) PET; (b) PI; (c) glass slides; (d) PET after treatment; (e) PI after treatment; (f) glass slides after treatment.

## 3. EDS energy spectra and SEM images of four precursor silvers

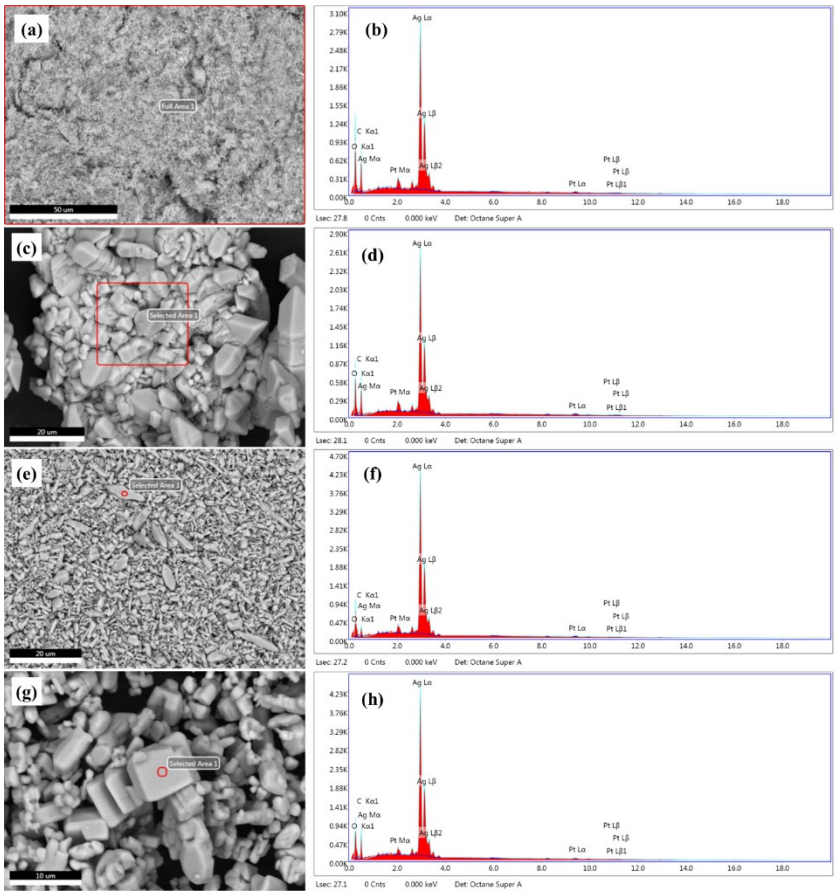


**Figure S3** (a, c, e, g) are the SEM images of silver citrate, silver tartrate, silver oxalate, and silver carbonate, respectively; (b, d, f, h) are the EDS spectra of silver citrate, silver tartrate, silver oxalate, and silver carbonate, respectively.


**Figure S4** Optical photograph of silver citrate, silver tartrate, silver oxalate, and silver carbonate.

## 4. Experimental part of performance optimization of conductive inks

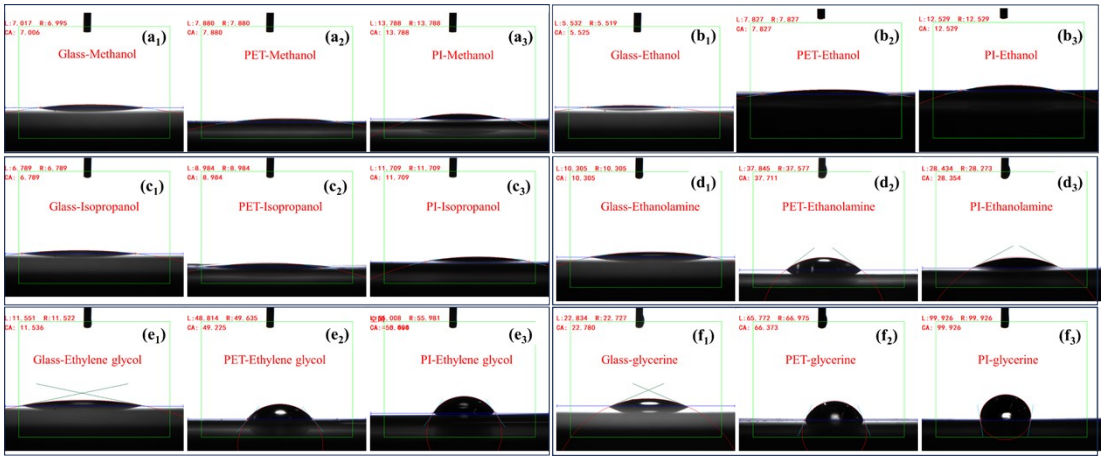


**Figure S5** Contact angle size of different solvents on different substrates:($a_1$~$a_3$) contact angle size of methanol on glass, PET and PI substrates; ($b_1$~$b_3$) contact angle size of ethanol on glass, PET and PI substrates; ($c_1$~$c_3$) contact angle size of isopropanol on glass, PET and PI substrates; ($d_1$~$d_3$) contact angle size of ethanolamine on glass, PET and PI substrates; ($e_1$~$e_3$) contact angle size of ethylene glycol on contact angle size on glass, PET and PI substrates; ($f_1$~$f_3$) contact angle size of glycerine on glass, PET and PI substrates;

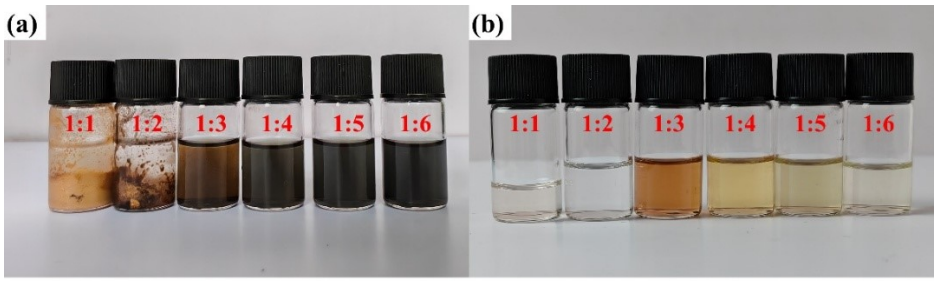


**Figure S6** Synthesis of ink using silver citrate and monohydrated ethylenediamine at different silver-to-amine molar ratios

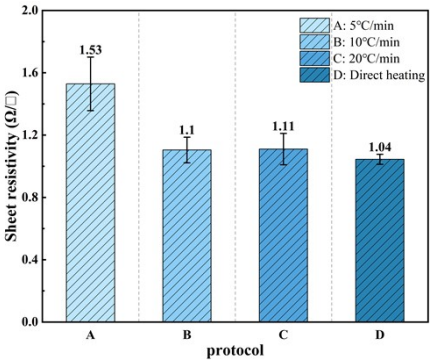


**Figure S7** The sheet resistance after sintering at 140℃ for 10 minutes under different heating rates

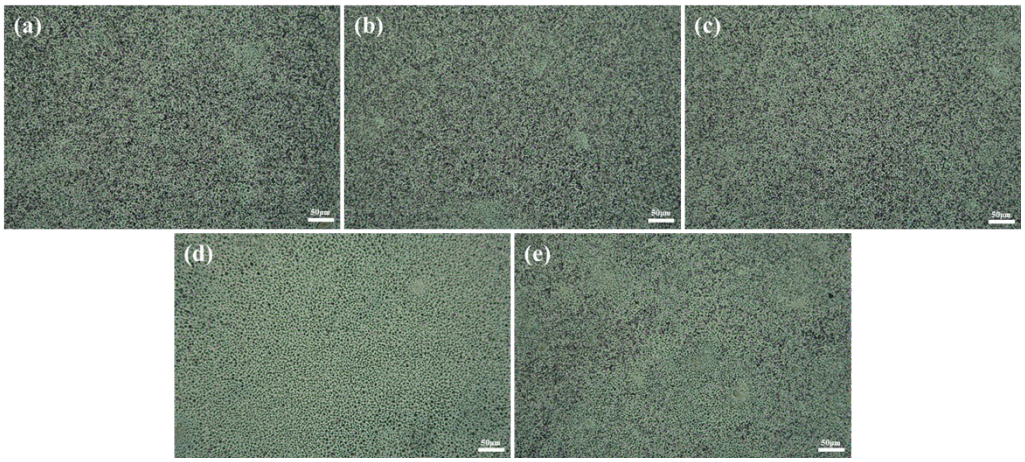


**Figure S8** (a, b, c, d, e) correspond to the metallographic images of the films formed by sintering the conductive inks at 500× magnification in Schemes A, B, C, D, and E in Table S4, respectively.

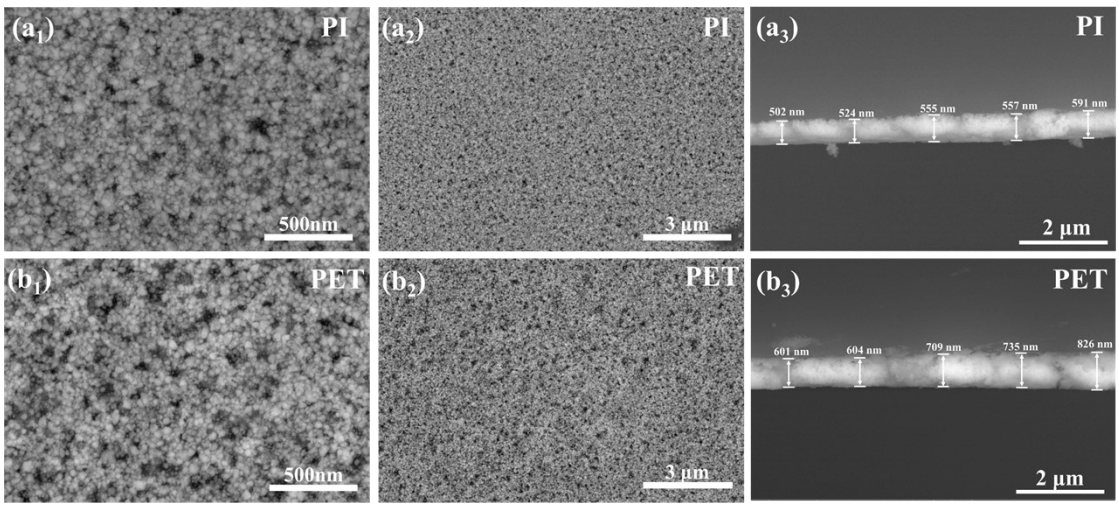


**Figure S9** (a1, a2) SEM of organically decomposed ink after sintering in air at 160 ℃ on PI substrate; (a3) SEM of cross-section after sintering in air at 160 ℃ on PI

substrate; (b1, b2) SEM of organically decomposed ink after sintering in air at 160 ℃ on PET substrate; (b3) SEM of cross-section after sintering in air at 160 ℃on PET substrate; (b4) SEM of cross-section of cross-section after sintering in air at 160 ℃ on PET substrate. (b3) SEM of cross-section after sintering of organically decomposed ink on PET substrate in air at 160 ℃;

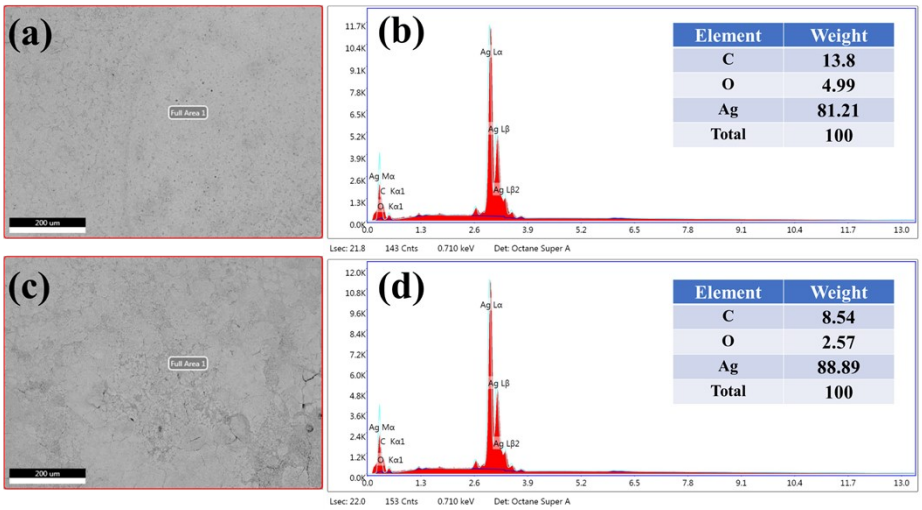


**Figure S10** (a) SEM after sintering of ink on PI substrate in air at 160℃ for 30 min; (b) EDS after sintering of ink on PI substrate in air at 160℃ for 30 min; (a) SEM after sintering of ink on PI substrate in nitrogen at 160℃ for 30 min; (b) EDS after sintering of ink on PI substrate in nitrogen at 160℃ for 30 min; (c) EDS after sintering of ink on PI substrate in nitrogen at 160℃ for 30 min. EDS;

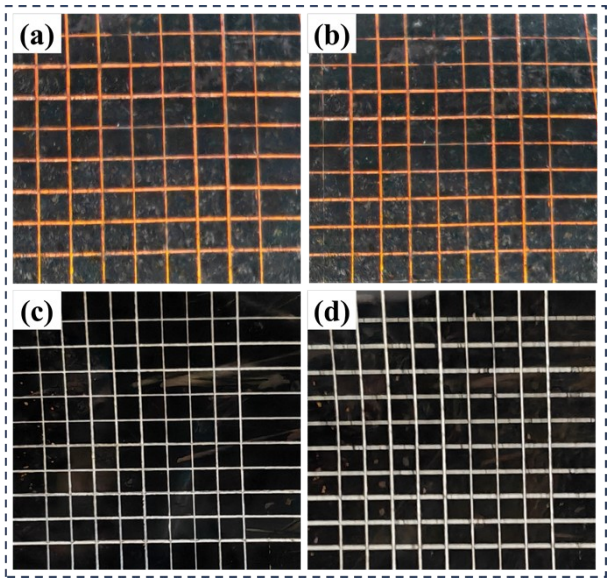


Figure S11 Adhesion test of ink on different substrates: (a) before test photo of ink on

PI film at 140℃ after sintering; (b) after test photo of ink on PI film at 140℃ after sintering; (c) before test photo of ink on PET film at 140℃ after sintering; (d) after test photo of ink on PET film at 140℃ after sintering

**Table S1** Dispersion of silver citrate in different organic solvents

| Scheme | Silver Precursor | Solvent | Viscosity (25℃) | Boiling Point | Solubility | Liquid State |
|---|---|---|---|---|---|---|
| A | Silver citrate | Methanol | 0.59 mPa·s | 64.7℃ | Slightly soluble | Pale yellow |
| B | Silver citrate | Ethanol | 1.20 mPa·s | 78.4℃ | Slightly soluble | Pale yellow |
| C | Silver citrate | Isopropanol | 2.45 mPa·s | 82.3℃ | Slightly soluble | Pale yellow |
| D | Silver citrate | Ethanolamine | 4.50 mPa·s | 170.8℃ | Dissolution reaction | Dark brown |
| E | Silver citrate | Ethylene glycol | 16.1 mPa·s | 197.3℃ | Slightly soluble | Pale yellow |
| F | Silver citrate | Glycerine | 945 mPa·s | 290.1℃ | Partial reaction | Dark yellow |

**Table S2** Complexation ability of different amines with silver citrate

| Scheme | Silver Precursor | Complexing Agent | Solvent | Reaction Speed | Ink Color |
|---|---|---|---|---|---|
| A | Silver citrate | Ethylamine | Ethanol | Fast | Pale yellow |
| B | Silver citrate | Propylamine | Ethanol | Relatively fast | Brown |
| C | Silver citrate | Isobutylamine | Ethanol | Relatively slow | Black |
| D | Silver citrate | Ethylenediamine monohydrate | Ethanol | Fast | Yellow |

**Table S3** Investigation of different silver-to-amine molar ratios in the reaction of silver citrate with monohydrated ethylenediamine

| Scheme | Silver Source | Complexing Agent | Silver/Amine Molar Ratio | Solvent | Observation |
|---|---|---|---|---|---|
| A | Silver citrate | Ethylenediamine monohydrate | 1:1 | Ethanol | Incomplete dissolution |
| B | Silver citrate | Ethylenediamine monohydrate | 1:2 | Ethanol | Incomplete dissolution |
| C | Silver citrate | Ethylenediamine monohydrate | 1:3 | Ethanol | Complete dissolution |
| D | Silver citrate | Ethylenediamine monohydrate | 1:4 | Ethanol | Complete dissolution |
| E | Silver citrate | Ethylenediamine monohydrate | 1:5 | Ethanol | Complete dissolution |
| F | Silver citrate | Ethylenediamine monohydrate | 1:6 | Ethanol | Complete dissolution |

**Table S4** Formulation Table of Conductive Ink with Composite Solvents

| Scheme | Silver | Complexing Agent | mixed solvent | reagent |
|---|---|---|---|---|

| | Source | | | |
|---|---|---|---|---|
| A | Silver citrate | Ethylenediamine monohydrate | Ethanol | Phenolic resins and PVP |
| B | Silver citrate | Ethylenediamine monohydrate | Methanol, Ethanol | Phenolic resins and PVP |
| C | Silver citrate | Ethylenediamine monohydrate | Methanol, Ethanol, DI | Phenolic resins and PVP |
| D | Silver citrate | Ethylenediamine monohydrate | Methanol, Ethanol, Isopropanol | Phenolic resins and PVP |
| E | Silver citrate | Ethylenediamine monohydrate | Methanol, Ethanol, Isopropanol, DI | Phenolic resins and PVP |

**Table S5** Ink formulations with different silver content

| **Scheme** | **Silver Source** | **Complexing Agent** | **mixed solvent** Methanol, Ethanol, Isopropanol | **reagent** |
|---|---|---|---|---|
| A | Silver citrate | Ethylenediamine monohydrate | 1.5ml | Phenolic resins and PVP |
| B | Silver citrate | Ethylenediamine monohydrate | 1ml | Phenolic resins and PVP |
| C | Silver citrate | Ethylenediamine monohydrate | 0.8ml | Phenolic resins and PVP |
| D | Silver citrate | Ethylenediamine monohydrate | 0.6ml | Phenolic resins and PVP |