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


# Supporting information

# A Water-Based Silver Nanowire Ink for Large-Scale Flexible Transparent Conductive Films and Touch Screens

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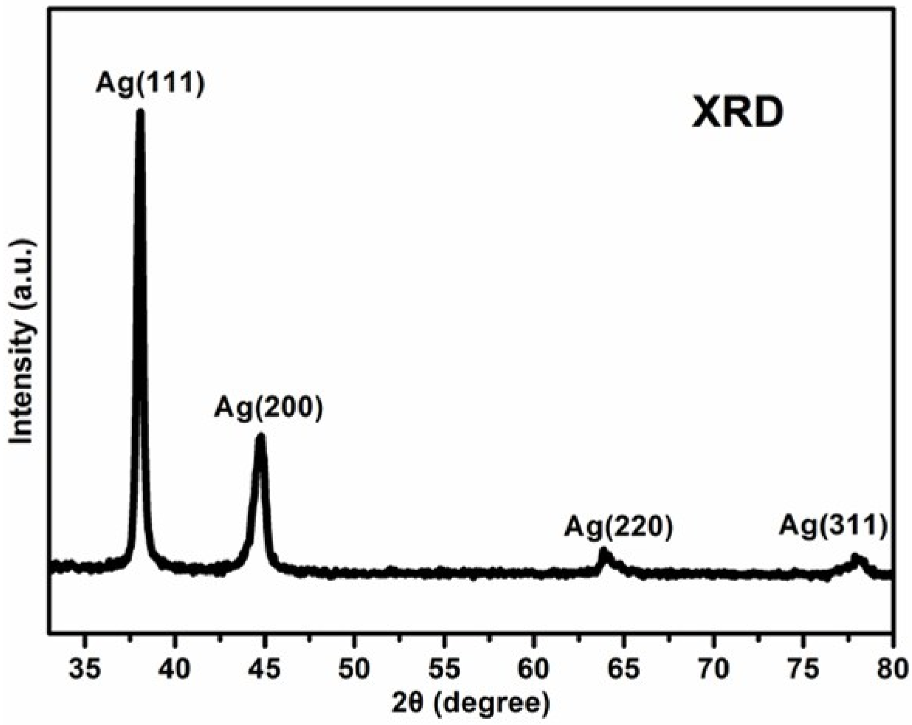



**Fig. S1** The XRD pattern of AgNW used in our ink.

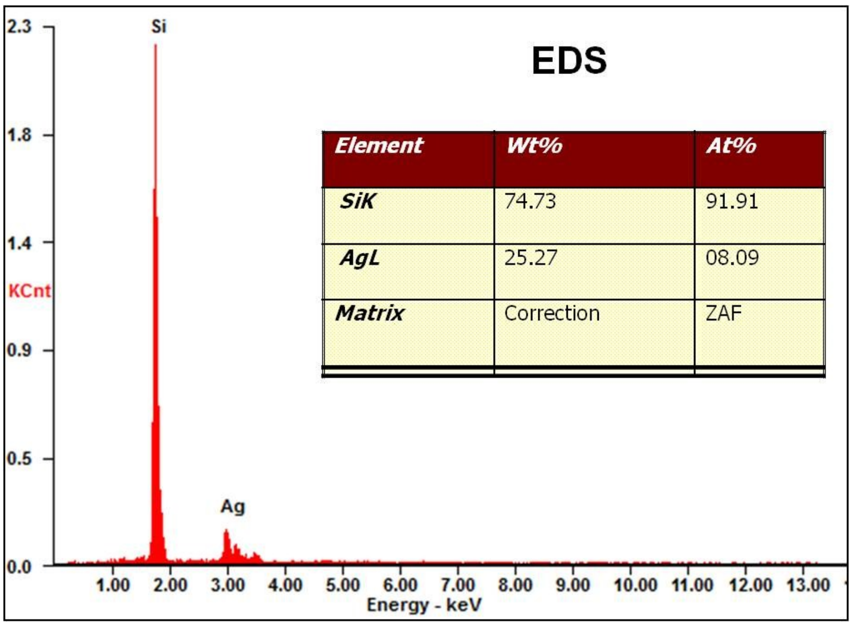



**Fig. S2** The EDS analysis of our AgNW on the silicon substrate.

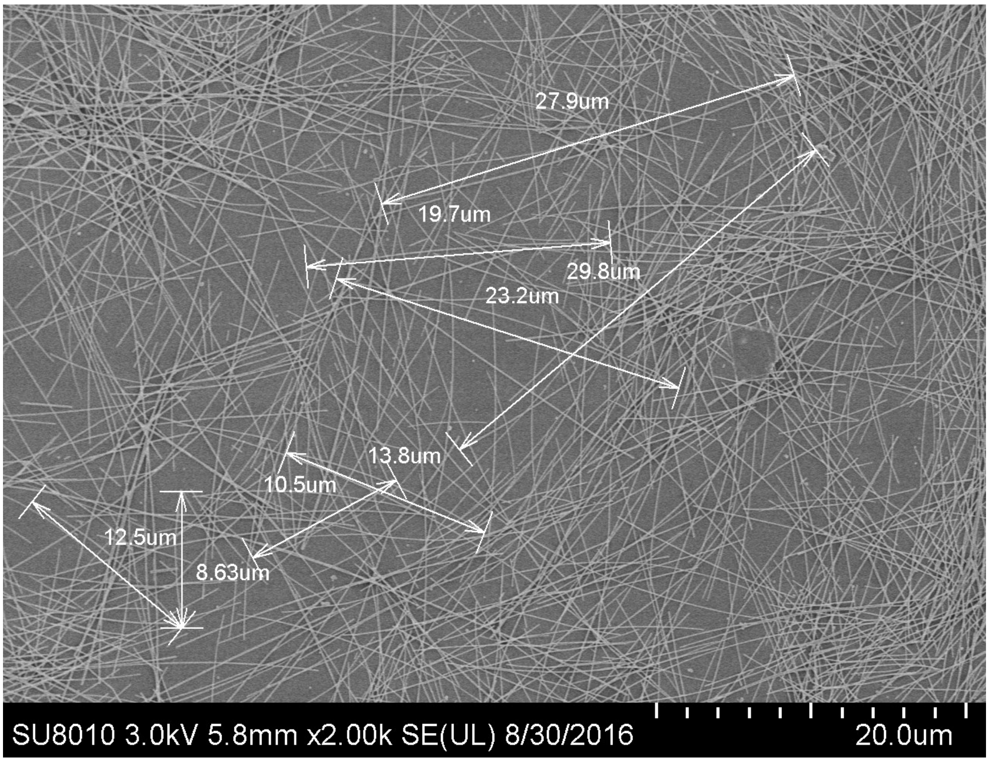



**Fig. S3** The SEM image (for length) of AgNW used in our ink.

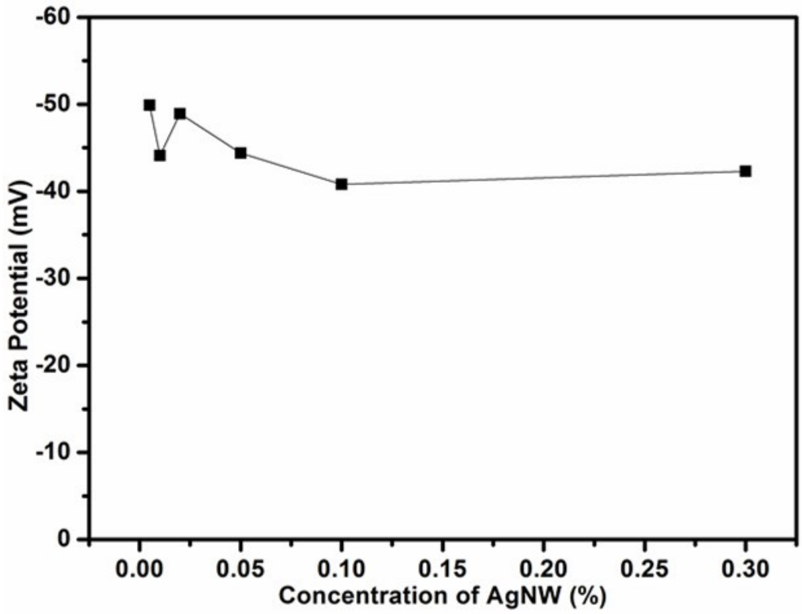



**Fig. S4** The Zeta potentials of inks with different concentrations (0.005%, 0.01%, 0.02%, 0.05%, 0.1% and 0.3% respectively) of AgNWs.

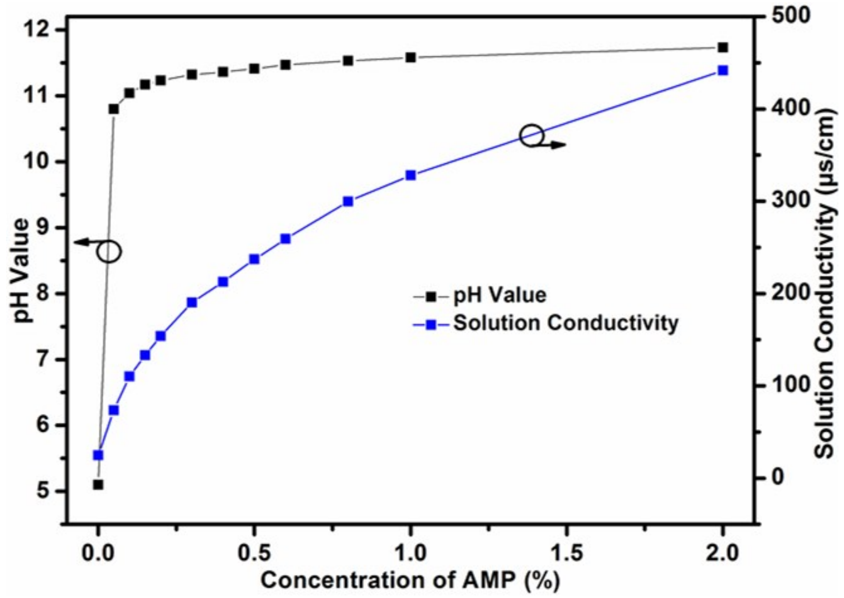
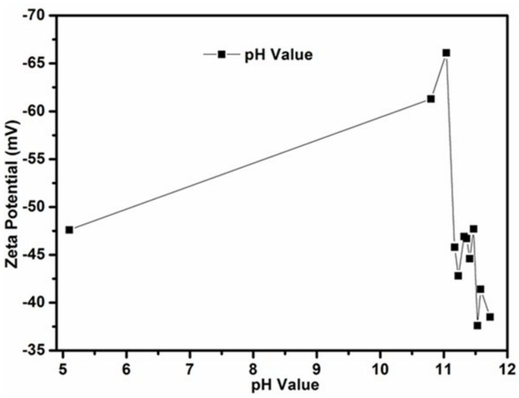
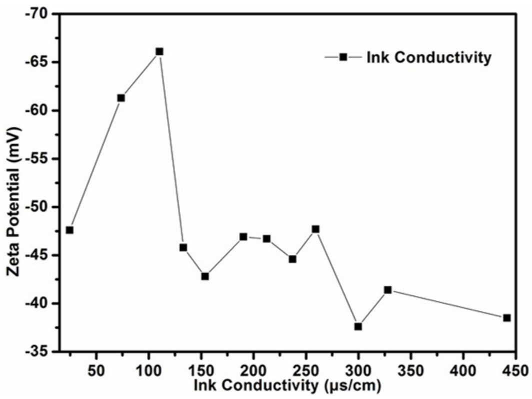



**Fig. S5** The pH value and solution conductivity of inks with different concentrations (0%, 0.05%, 0.1%, 0.15%, 0.2%, 0.3%, 0.4%, 0.5%, 0.6%, 0.8%, 1.0% and 2% respectively) of AMP.




(a)




(b)

**Fig. S6** The variation of Zeta Potential with the variation of (a) pH value and (b) conductivity of inks.

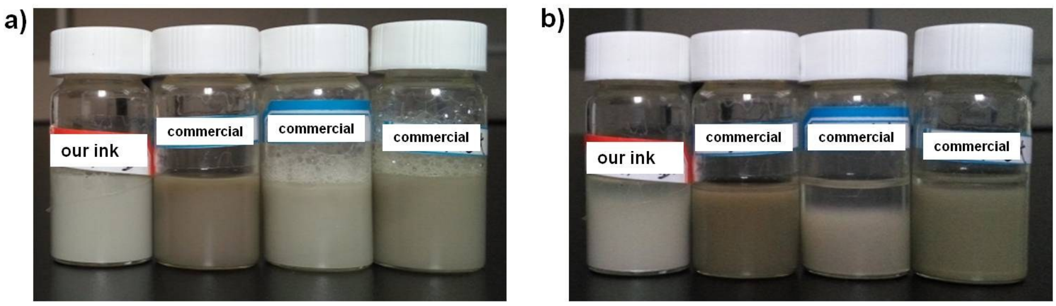



**Fig. S7** Photos of our ink and commercial inks from three companies (a) after shaking and standing for one hour and (b) standing for two weeks.


**Fig. S8** The surface tensions of pure water and inks with different concentrations (0%, 0.005%, 0.01%, 0.015%, 0.02%, 0.025%, 0.03%, 0.04%, 0.05% and 0.06% respectively) of Zonyl FSO-100.

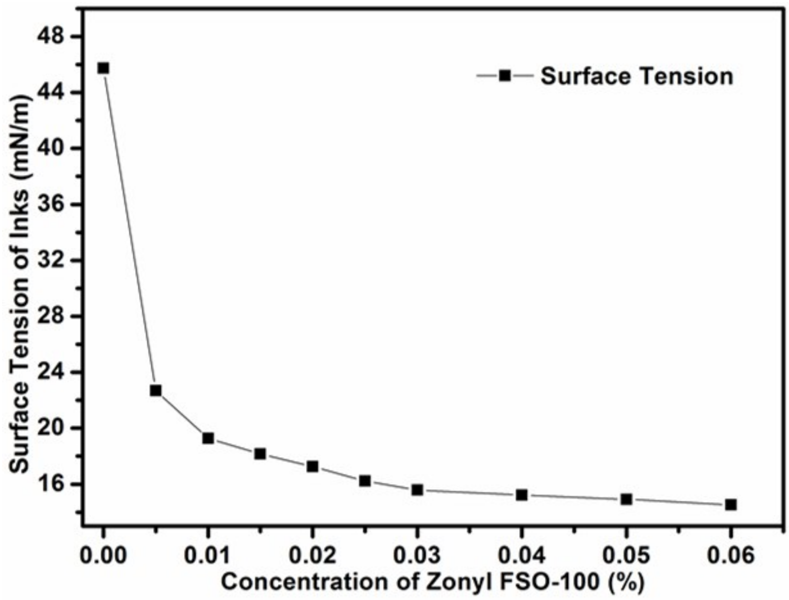



**Fig. S9** The surface tensions of inks with different concentrations (0%, 0.005%, 0.01%, 0.015%, 0.02%, 0.025%, 0.03%, 0.04%, 0.05% and 0.06% respectively) of Zonyl FSO-100.

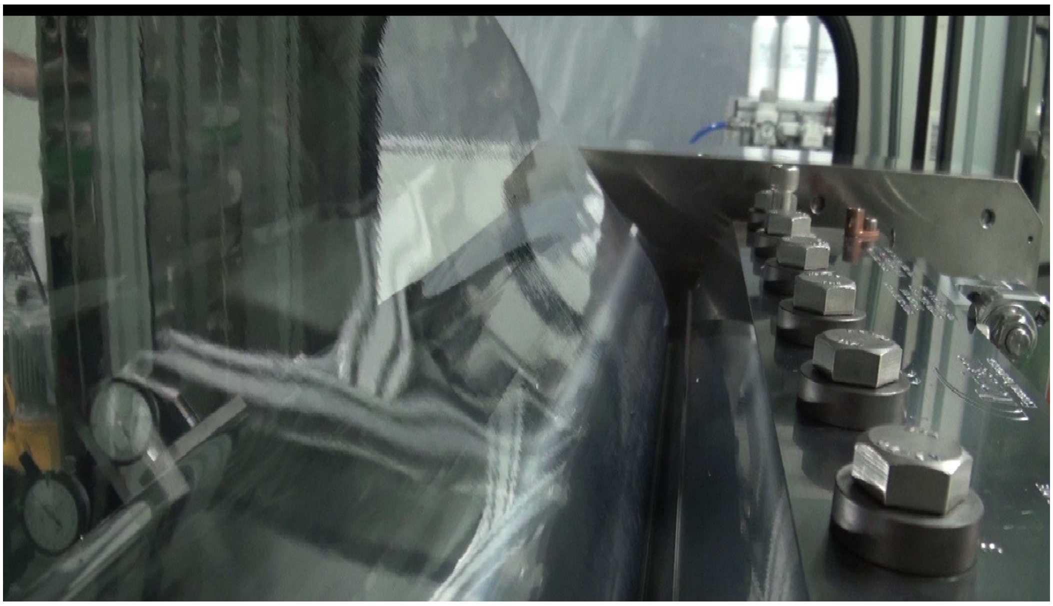


**Fig. S10** The sine waves observed after the ink was put onto the substrate.

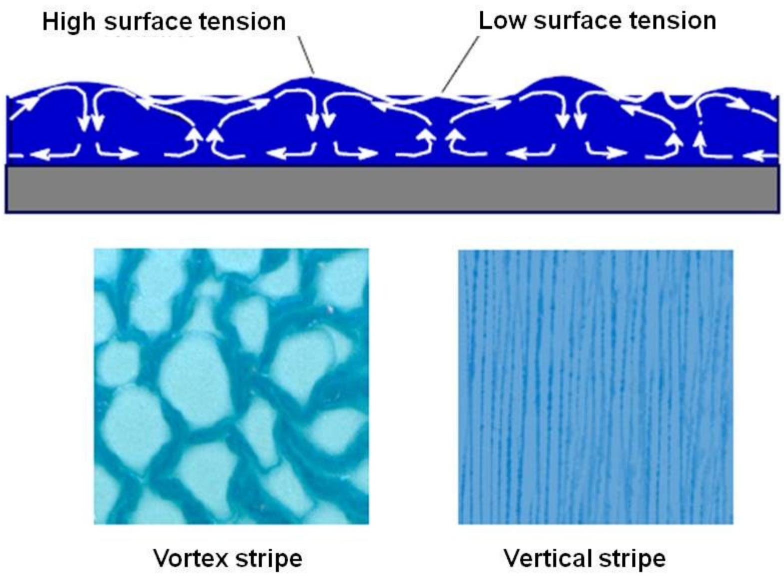



**Fig. S11** The Bénard cell (upside) and defects (underside) caused by it.

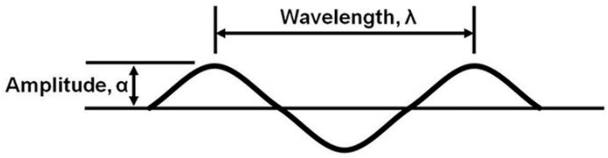



**Fig. S12** The sine-wave flow model of the wet film.

Rhodes & Orchäd equation:

$$\Delta t = k\frac{\lambda^4\eta}{\gamma d^3}\ln\frac{\alpha_0}{\alpha_t}$$

Here, $\Delta t$ is the flow time from the sine-wave state with relatively large initial amplitude ($\alpha_0$) to the flatter state with smaller amplitude ($\alpha_t$). k is a constant. $\lambda$ is the wavelength of sine wave. $\eta$, $\gamma$ and d represent the viscosity, surface tension and thickness of the liquid layer respectively.

According to this equation, at the beginning of the wet film which is the spreading of inks on the substrates, $\Delta t$ is shortest because the unevaporated solvent brings about the smallest viscosity and the thickest liquid layer. Therefore, at the beginning, levelling can proceed more easily. However, in the later period of the wet film, along with the evaporation of solvent, $\Delta t$ becomes longer because of the larger viscosity and smaller thickness of the wet film. The problem of long Δt is that the leveling of the wet film can't be finished before the solvent is evaporated completely. And this will cause nonuniformity for final films. Compared to the long Δt, the more serious problem is the appearance of the gradient of surface tension (**Fig. S7**) that can bring about many problems, such as Bénard cell, brushmark, and so on. For these problems, adding additives which can lower the surface tension of the wet film can't provide much help. At this time, efficient leveling agents that can adjust the gradient of surface tension are essential.

Generally, the leveling agents will firstly move to the surface of the wet film and then gather at the bottom of the wave. If the surface tension of the leveling agent is low, the sine wave will be stabilized. On the contrary, leveling agents with relatively high surface tension will make the bottom areas unstable and provide power for the leveling of the wet film. Obviously, leveling agents with relatively high surface tension are favorable for controlling the flow of the wet film in the later period.

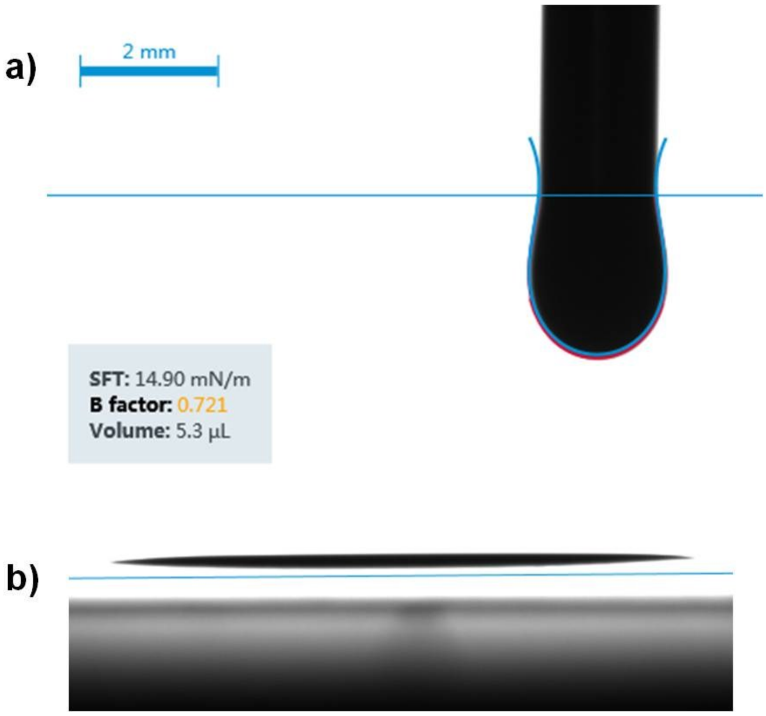



**Fig. S13** (a) The surface tension of the final ink and (b) the wettability between the final ink and PET.

**Fig. S14** The roll-to-roll printing machine used in our experiment.

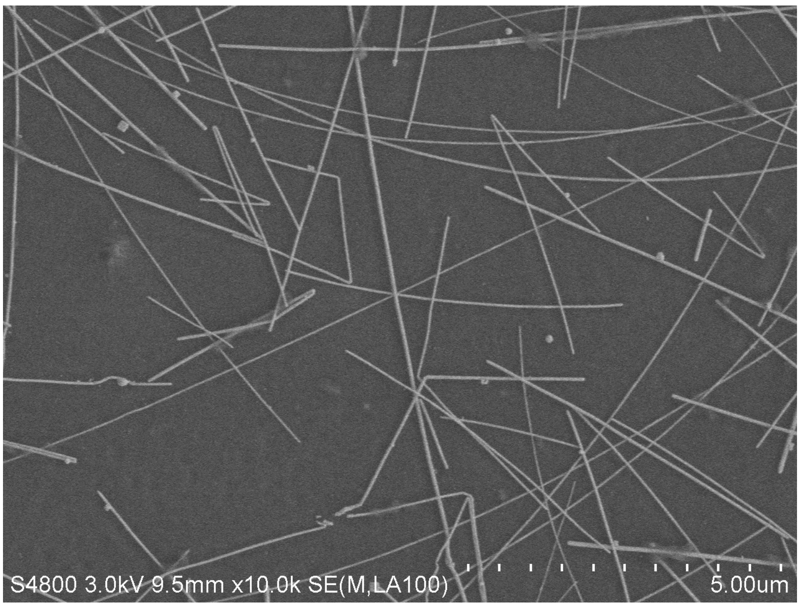



**Fig. S15** The SEM image of AgNW network in the large-scale flexible film.