WASER Supporting Information: Material Fabrication

1 FABRICATION METHOD

The fabrication process has three steps: (1) LCE synthesis; (2) LCE photoalignment; (3) deposition of soft conductive films. Steps 1 and 2 are based on work by [1], while Step 3 is adapted from [2, 3]. The LCE is fabricated by mixing 1.500 grams of 1,4-bis-[4-(6-acryloyloxyhexyloxy)-benzoyloxy]-2-methylbenzene monomer (RM82, Wilshire Chemicals), 0.116 grams of n-butylamine chain extender molecule (Sigma Aldrich), and 0.025 grams of Irgacure I-369 photoinitiator. This was heated using a heat gun until the materials had dissolved. This is followed by three cycles of vortex mixing (Scilogex MX-F) for 40 seconds and heating. For the photo alignment setup, two 75×50 mm glass slides were cleaned using IPA and Acetone. To guarantee good bonding between the photoalignment dye and glass surface, the slides were treated with oxygen plasma at at 50 mW power and 100 mTorr pressure for 2 minutes. The photoalignment dye, brilliant yellow (Sigma Aldrich), was dissolved by 1% weight in DMF (Sigma Aldirch). Using a 0.45 m filter, this solution was coated onto the surface of the slides and then spin coated for 750 rpm for 10 seconds and 1500 rpm for 30 s. Using a polarizing lens (Thorlabs LCRM2/M) placed in front of a projector (Vivitek) six inches apart, each slide was placed in front of the polarizer to photo-align along one direction. Once the two slides were photoaligned along the same director, they were bonded together with 50 m spacer separating them. The bonded slides were then placed on a hot plate at 80 °C with the LCE material inserted between the slides using capillary action. After the cell has been filled, the setup is moved to a 70 °C oven for 16 hours for oligomerization. In order for polymer crosslinking to occur, and induce bending, the setup was placed in a UV chamber (UVP CL-1000 ultraviolet crosslinker) at 254 nm for 20 minutes on each side. The slides were then broken open and the LCE was removed. The LCE was then placed on a slide, coated with polyvinyl alcohol (PVA) (5 wt % aqueous solution), and spin coated for 1 minute at 2000 rpm. PVA was used to guarantee a smooth and uniform conductive layer. Next silver ink (Metalon JS-A102A) was airbrushed (Master airbursh G22) for 40 passes at 6 inches to place a uniform coat of silver ink into the LCE. The solvent was then evaporated for 12 hours at 60 °C. In order to make this surface conductive for heating, eutectic Gallium Indium liquid metal (EGaIn) is wetted onto the deposited Ag surface. This combination of Ag and LM creates percolating pathways between Ag flakes and produces a continuous Ag-In-Ga film [2, 3].

REFERENCES

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[2] André F Silva, Hugo Paisana, Tânia Fernandes, Joana Góis, Arménio Serra, Jorge FJ Coelho, Aníbal T de Almeida, Carmel Majidi, and Mahmoud Tavakoli. 2020. High resolution soft and stretchable circuits with PVA/liquid-metal mediated printing. *Advanced Materials Technologies* 5, 9 (2020), 2000343.

[3] Mahmoud Tavakoli, Mohammad H Malakooti, Hugo Paisana, Yunsik Ohm, Daniel Green Marques, Pedro Alhais Lopes, Ana P Piedade, Anibal T de Almeida, and Carmel Majidi. 2018. EGaIn-Assisted Room-Temperature Sintering of Silver Nanoparticles for Stretchable, Inkjet-Printed, Thin-Film Electronics. *Advanced Materials* 30, 29 (2018), 1801852.

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