

## Supporting Information

### **A Novel Liquid Metal Patterning Technique: Voltage Induced Non-Contact Electrochemical Lithography at Room Temperature**

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#### **Experimental Section**

The galinstan (62% Ga, 22% In, and 16% Sn by weight) was purchased from Alfa Aesar. The alloy has a low melting point (10.7 °C). A 40.8 mm inner diameter of the copper ring cathode was prepared. NaCl solutions were adjusted using 99% NaCl and deionized water. The deionized water was prepared by Purelab Ultra Elga. The liquid metal hole formation processes were recorded using a video camera. In the experiments, about 30 mL of 0.01 mol/L NaCl solution is added to the vessel. A copper wire anode (0.1 mm in diameter and 7 cm in length) is placed above the top center of the liquid metal film at a distance  $h$ .

The galinstan films were prepared on an insulated, transparent vessel. About 20-50  $\mu\text{L}$  of galinstan droplet was put in the vessel. Then shaking the vessel to make sure the galinstan fully covers and sticks on the glass surface. As a result, the liquid metal wets or sticks to the glass surface. Then suctioning out the remaining liquid metal using a pipette as much as possible so that a thin liquid metal layer was formed. Using the weight and area of liquid metal film, the average thickness of the liquid metal films can be calculated, which are about 15-20  $\mu\text{m}$ .

The voltage was generated by a GW laboratory DC power supply, model GPS-1850. A video camera was placed over the vessel and recorded the whole process of the experiment via 33fps video. Analysis was performed using the open-source ImageJ software with the spatial scale calibrated to an in-image standard, using a piece of blue reference paper placed under the vessel. The camera was timed to record the liquid metal when the power supply was switched on and off.

Three conductive polymer electrodes in geometric shapes were fabricated by using a 3D printer (Me3D, Australia). The conductive polylactic acid (PLA)-based filament was purchased from BlackMagic3D with resistance of 0.6 ohm cm and 220 °C printing temperature. The 3D geometric pattern images were drawn by using 3D Builder, and were printed in a few minutes for each CP electrode. The electrodes had a diameter or side lengths of 20 mm for the circle, triangle, and square, and a thickness of 2 mm with height  $h = 3$  mm. Then, slim cylinders with a diameter of 1.3 mm and height of 50 mm were printed to connect with the geometric pattern.

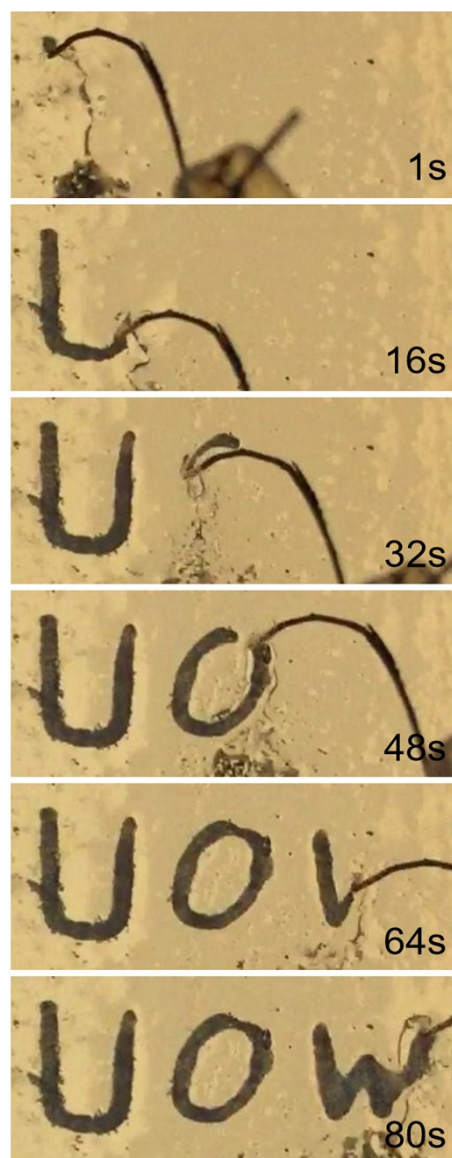


Figure S1 Snapshots of "UOW" logo formed by using a continuous writing method.