Title

High throuput electrochemically driven metal microprinting with multicapillary droplet cell

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Supporting information

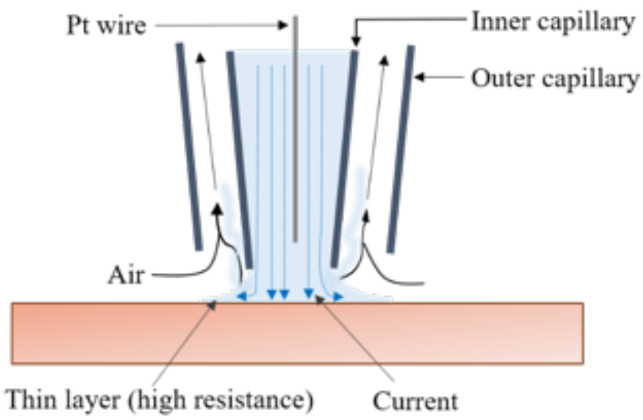

Fig. S1 Schematic representation of single capillary showing solution flow and direction of current

The total mass of the deposit was calculated using the following equation:

$$\boldsymbol{m = \frac{I \times t \times M}{n \times F}}$$

$$\boldsymbol{m = \frac{0.3\,mA \times 8000\,s \times 58.7\,g}{2 \times 96485\,C/mol} = 0.73\,mg}$$

Where, m is the total mass of simultaneously printed lines, I is the applied current, t is the electrodeposition time, M is the molar mass of Nickel, n is the number of electrons and F is the Faraday's constant (96485 C/mol). Using the theoretical density of Nickel as 0.0089 g/cm^3, the theoretical volume of deposit (Volume = mass/density) was calculated to be around 0.81 mm^3. The height of simultaneously printed lines can be calculated by dividing the volume of deposit by the area of the electrode ($A = \pi r^2$). Ideally, the height of simultaneously deposited lines should have been the same. However, due to significant IR drop, variation in droplets sizes and instabilities during the process, the variation in the current passing through each capillary, the actual heights and volumes of simultaneously printed lines are significantly different.
Assuming the shape of the deposit closest to a trapezium, the volume of deposit was calculated from the following equation:

Volume of trapezium = L * (b1 + (b2 - b1) * h1 / h + b1) * h1 / 2

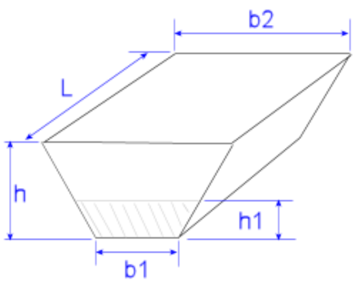

Fig. S2 Parameters showing the volume of trapezium

The total volume of simultaneously printed lines was calculated by summing up the individual volumes of three lines at two different scanning speeds (2 μms^{-1} and 4 μms^{-1}), as shown in Fig. 3 (a). The resulting values are as follows:

$$\text{Total volume} = \text{Volume of three lines at } 2\ \mu ms^{-1} + \text{Volume of three lines at } 2\ \mu ms^{-1}$$

$$V_t = (0.048 + 0.020 + 0.017) + (0.030 + 0.013 + 0.008) = 0.133\ mm^3$$

Influence of temperature on the height of deposits:

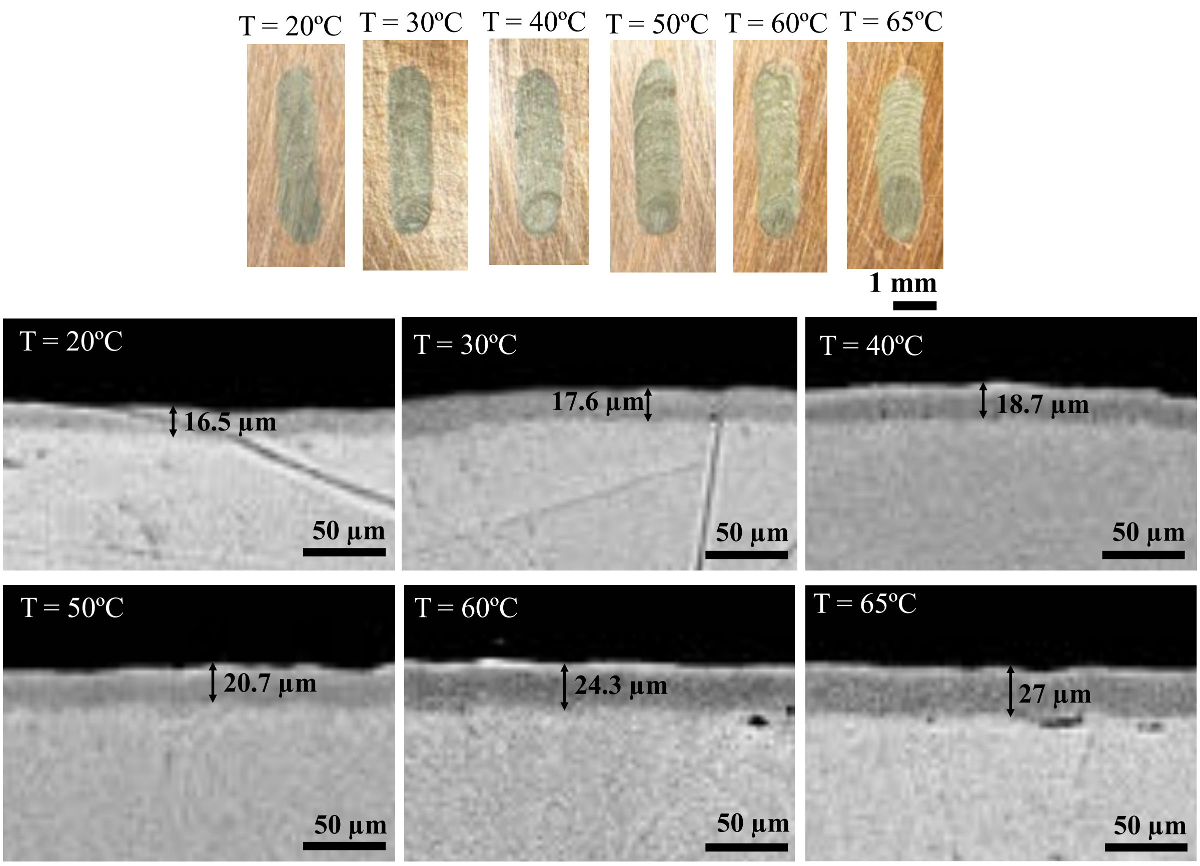

Fig. S3 Optical microscope (top) and cross-sectional SEM images (middle and bottom) of the electrodeposited lines fabricated at different temperatures.

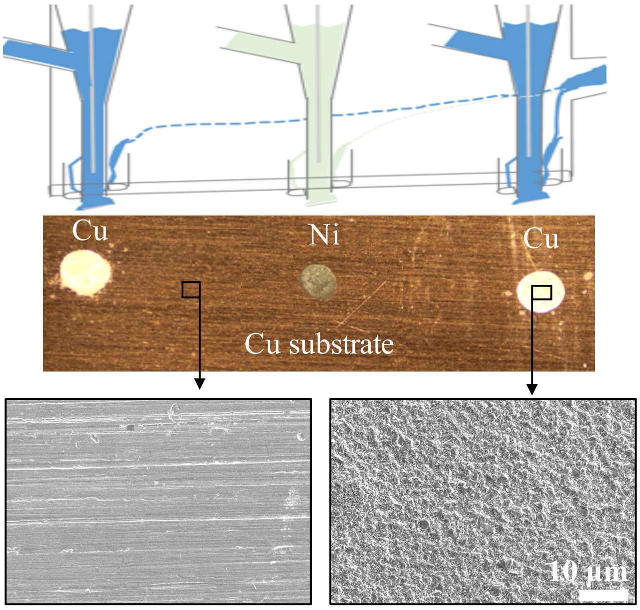

Fig. S4 Schematic of simultaneous electrodeposition using Ni and Cu solutions (upper) and corresponding optical (middle) and SEM images (bottom).

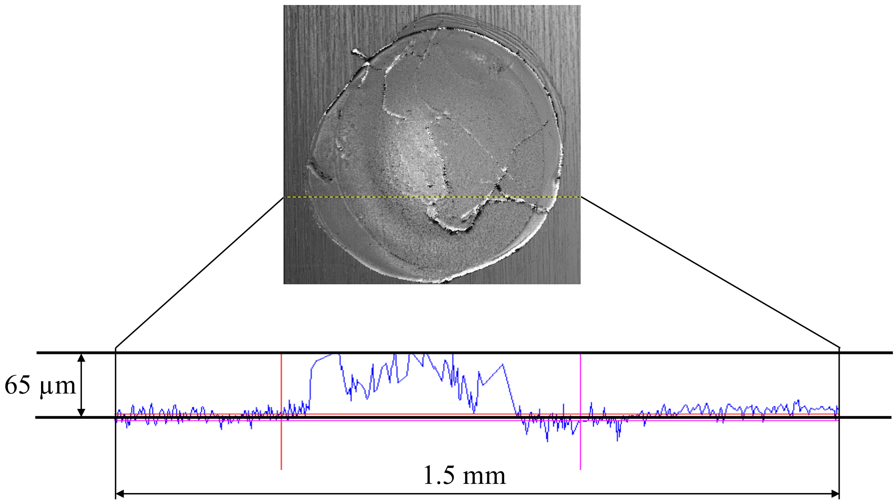

Fig. S5 CSLM image and height profile of Cu deposit.