**Additive Manufacturing of High-Resolution and High-Performance Metal Conductors Using Inkjet Printing, Capillary Flow, and Electroless Plating on Plastic Substrates**

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**Extended Abstract:**

In printed electronics, a reliable method is needed to additively manufacture high-resolution, low-resistance, flexible metal interconnects. These structures link together multiple discreet devices to create a complete electronic circuit. A two-step additive manufacturing process to address this need will be discussed in this presentation. In the first step, an aqueous silver ink is inkjet printed into capillary channels molded on a plastic flexible substrate. The patterned substrates are prepared with roll-to-roll UV micro imprinting.1 The annealed silver ink serves as a seed layer for selective electroless copper plating in the second step of the process. The imprinted features are fully filled with copper through the electroless copper plating process. We identified that defects present in the silver ink deposition are magnified in the copper electroless plating process. We have identified ideal printing conditions for uniform silver ink deposition without defects by investigating the effects of humidity, flow time and channel geometry on silver ink deposition and we have developed process windows to guide printing conditions based on these investigations. Improvements in the copper electroless plating process have been guided by studies that uncovered stress development, likely caused by hydrogen incorporation, as a primary source of the defects. By adding polyethylene glycol to the plating solution as a wetting agent, the stress-induced defects were removed, resulting in flexible metal conductors with linear resistances of a few ohms / cm and excellent endurance to bending through 1000 bending cycles. The conductor fabrication process presented in this work also fully fills 10 μm deep capillaries with metal to additively manufacture high-aspect ratio metal conductors. The final metal interconnects demonstrate excellent uniformity, durability, and electrical conductivity and all processing steps are compatible with roll-to-roll processing for high-throughput manufacturing.

1) Jochem, K. S.; Suszynski, W. J.; Frisbie, C. D.; Francis, L. F. High-Resolution, High-Aspect-Ratio Printed and Plated Metal Conductors Utilizing Roll-to-Roll Microscale UV Imprinting with Prototype Imprinting Stamps. Industrial & Engineering Chemistry Research. 2018, 57 (1), 16335-16346.