

Flexible Electronics by the SCALE (Self-Aligned Capillarity-Assisted Lithography for Electronics) Process

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Continuous printing processes are attractive for manufacturing electronic devices on flexible substrates. Two challenges typically arise in this pursuit: (1) creating small feature sizes, and (2) achieving registration of multiple functional layers. This presentation will cover our efforts to address these challenges using a new processing route – The Self-Aligned Capillarity-Assisted Lithography for Electronics (or SCALE) process¹. SCALE involves creating a multilevel, recessed open network of reservoirs, capillaries and device structures in a UV curable polymer layer by an imprinting process, delivering electronically functional inks into the reservoirs by inkjet printing and using capillarity to selectively and sequentially fill features to create electronic components, devices and circuits. To-date we have used SCALE to create conductive networks, resistors, capacitors, diodes and transistors. This presentation will show advances in device architecture and performance, and explore the key processing steps, including imprinting and process design for roll-to-roll operation and liquid ink flow and drying in open channels. Special attention will be given to experiments and visualizations of liquid flow in open capillary channels². Control of this flow is critical to device design and depends on the channel geometry, ink properties, drying behavior and interaction with the capillary walls. Results for both model liquids and electronically functional inks will be presented.

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