Currently there is great interest in developing manufacturing methods for integrating electronic circuitry into flexible and stretchable substrates for a spectrum of applications including roll-up displays, wearable biosensors, smart labels, and electronic skins (‘e-skins’) for robotics, for example. One fabrication strategy that has captured imaginations involves the use of digital or analog printing techniques to pattern electronically functional inks onto paper, plastic, rubber, or metal foils. However, “printed electronics” has a number of significant challenges, including spatial resolution, pattern registration, and printed circuit performance. In this talk, I will describe a multi-pronged approach to address these challenges that may bring roll-to-roll printed electronics closer to reality. To begin, I will show that innovations in materials allow the fabrication of printable, low voltage thin film transistors (TFTs), the key building blocks of flexible circuits, and that these can be incorporated into simple printed circuit demonstrations involving two dozen TFTs and an equivalent number of printed resistors and capacitors. The second half of the talk will describe a novel liquid-based fabrication approach that we term SCALE or Self-Aligned Capillarity-Assisted Lithography for Electronics. The SCALE process employs a combination of digital printing and in-substrate capillary flow to produce self-aligned devices with feature sizes that are currently as small as 1 µm. The talk will finish with a discussion of the new opportunities in flexible microelectronics afforded by liquid-based processing.

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