Fully-Printed Organic Thin-Film Transistors with 1-micron resolution

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Shrinking device dimensions to the few-micron scale is the primary step in manufacturing high-resolution electronics. Particularly in the field of high-definition liquid crystal displays, thin-film transistors with channel lengths of no more than 5 μm are typically required. Fully printing of organic thin-film transistors (OTFTs) currently becomes considerably interesting.¹,²

We developed a high-resolution printing technique based on parallel vacuum ultraviolet (PVUV) patterning that can produce high-contrast wettability regions on flexible substrates. We used this technique to selectively deposit a functional ink with a 1-μm feature size, thereby allowing the large-scale fabrication of OTFTs with channels as short as 1 μm under ambient atmosphere, as shown in Figure 1. Moreover, in short-channel devices, hole injection barriers can be tuned through printing the optimum gate overlaps associated with selectively doping semiconductor/electrode interfaces, resulting in a marked reduction in contact resistance from 20 to 1.5 kΩ cm, and an elevation of charge carrier mobility to a record high of 0.3 cm² V⁻¹ s⁻¹ in a 1-μm-channel device.³ The results indicate that this technique is promising for the fabrication of large-area, high-resolution, low-cost electronics.

Figure 1 Fabrication process of fully-printed flexible OTFT devices