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 cm^2 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.

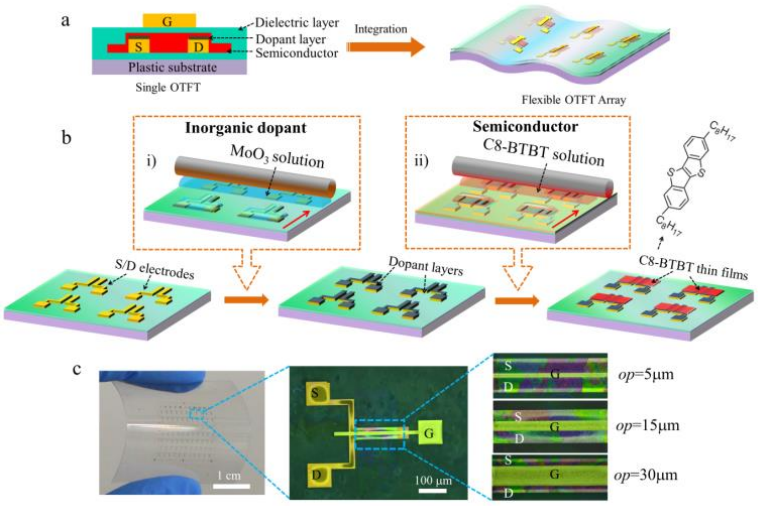

Figure 1 Fabrication process of fully-printed flexible OTFT devices

[1] T. Minari, C. Liu, M. Kano, K. Tsukagoshi, *Adv. Mater*. 2012, 24, 299-306.

[2] T. Minari, Y. Kanehara, C. Liu, K. Sakamoto, T. Yasuda, A. Yaguchi, A. Tsukada, K. Kashizaki, M. Kanehara, *Adv. Func. Mater*. 2014, 24, 4886-4892.

[3] X. Liu, M. Kanehara, C. Liu, K. Sakamoto, T. Yasuda, J. Takeya, and T. Minari, *Adv. Mater*. 2016, DOI: 10.1002/adma.201506151.