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Organic Thin-Film Transistors Fabricated on Flexible Substrate by Using Nanotransfer Molding

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We report a new direct patterning method, called liquid bridge-mediated nanotransfer molding (LB-nTM), for the formation of two- or three-dimensional structures with feature sizes between tens of nanometers and tens of micron over large areas. LB-nTM is based on the direct transfer of various materials from a mold to a substrate via a liquid bridge between them. This procedure can be adopted for automated direct printing machines that generate patterns of functional materials with a wide range of feature sizes on diverse substrates. Arrays of TIPS-PEN TFTs were fabricated on 4" polyethersulfone (PES) substrates by LB-nTM using PDMS molds. An inverted staggered structure was employed in the TFT device fabrication. A 150 nm-thick indium-tin oxide (ITO) gate electrode and a 200 nm-thick SiO2dielectric layer were formed on a PES substrate by sputter deposition. An array of TIPS-PEN patterns (thickness: 60 nm) as active channel layers was fabricated on the substrate by LB-nTM. The nominal channel length of the TIPS-PEN TFT was 10 mm, while the channel width was 135 mm. Finally, the source and drain electrodes of 200 nm-thick Ag were defined on the substrate by LB-nTM. The TIPS-PEN TFTs can endure strenuous bending and are also transparent in the visible range, and therefore potentially useful for flexible and invisible electronics.