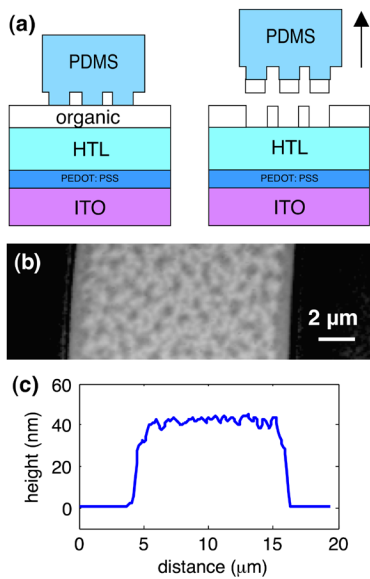


Micro-patterning Organic Thin Films via Contact Stamp Lift-off for Organic Light-emitting Device Arrays

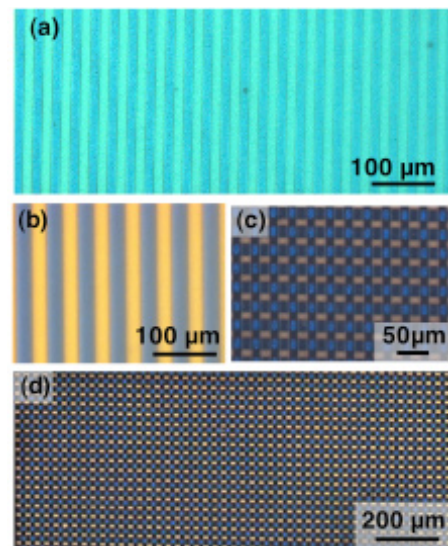
J. Yu, V. Bulović
 Sponsor: CMSE, PECASE

Patterning of organics in electronic devices is done primarily by techniques that are limited in resolution or scalability or are potentially damaging to the organic material. We demonstrate a simple subtractive stamping technique for patterning micron-sized features on organic thin films of nanometer-range thickness. Patterning is achieved by placing a relief-patterned polydimethylsiloxane (PDMS) stamp in contact with an organic film and peeling off the stamp (Figure 1a). The procedure is done without applied pressure or heat and can be done in an ambient environment, although a nitrogen environment is preferred for organic light-emitting device (OLED) fabrication. This technique is applied to pattern 13 micron-sized features of a two-color OLED structure.

To fabricate a two-colored OLED, a hole-blocking or emissive layer is patterned using this technique. The in-plane roughness of the patterned feature is shown in the height image of a patterned stripe (Figure 1b) and a profile of the patterned feature is shown (Figure 1c). Electroluminescence (EL) from blue-green device with 13-micron-sized features is shown (Figure 2a), and EL from blue-red devices of 25-micron-sized features is shown (Figure 2b). This technique can be applied twice to pattern blue-red devices with finer features (Figure 2c, d).



▲ Figure 1: (a) Demonstration of the subtractive stamping technique. Placing PDMS stamp to the substrate and subsequent release lifts off organic thin film from substrate surface. (b) Top view of in-plane patterned 20-nm TAZ on 50-nm TPD / PEDOT:PSS / ITO / glass substrate from AFM. (c) AFM height data to view lift-off patterned region.



▲ Figure 2: (a) EL of green-blue OLED from patterned hole-blocking layer for AlQ_3 (green) or TPD (blue) emission. (b) EL of red-blue OLED from a patterned emissive layer $DCM_2:AlQ_3$ (red) or TPD (blue) emission and EL from red-blue patterned OLED by stamping twice to define finer features in (c) with a zoomed-out version (d).