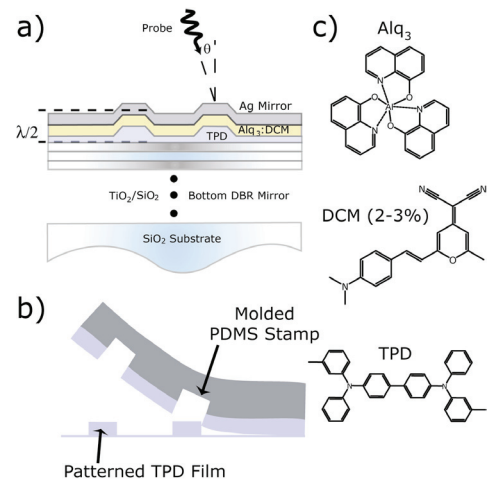


# Patterned Organic Microcavities for Confinement of Exciton-Polaritons

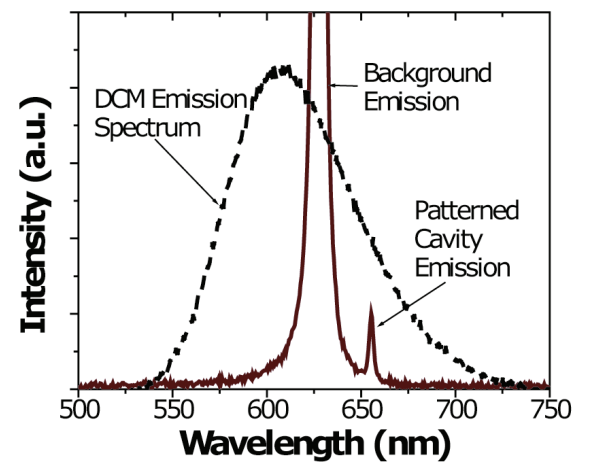
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We demonstrate fabrication of organic laterally-patterned microcavity devices with lateral sizes on the micron scale using PDMS lift-off patterning. Recently, low-threshold lasing was demonstrated from pillars formed by thermally evaporating thin films of Alq<sub>3</sub> (aluminum tris(8-hydroxyquinoline)) doped with the laser dye DCM (4-(dicyanomethylene)-2-methyl-6-(4-dimethylaminostyryl)-4H-pyran) through thin nickel shadow masks with square, 5- x 5-μm<sup>2</sup> openings [1]. Additionally, recent research efforts in microcavity exciton-polariton devices based on inorganic active materials such as GaAs or CdTe quantum wells have focused on the lateral patterning of microcavity exciton-polariton systems [2]. Such 0D cavities allow for symmetry-breaking of the in-plane wave vector, opening new pathways for parametric generation of photon pairs [3]. For the same reason, laterally-patterned organic microcavity exciton-polariton devices are also of interest. The PDMS lift-off patterning, as opposed to shadow masking, allows standard lithography techniques to be used to define pattern features in silicon PDMS molds [4], [5]. Additionally, smaller features than are achievable through shadow masking are theoretically feasible even with PDMS due to the generally low aspect ratio in PDMS needed for embossing small features on the patterned organic film.

We use PDMS lift-off patterning of a thin film of thermally-evaporated TPD (N,N'-bis(3-methylphenyl)-N,N'-diphenyl-1,1'-biphenyl-4,4'-diamine) doped with DCM to form embossed pillars in the TPD film of 20-25 nm in thickness. Figure 1a shows the device structure, Figure 1b shows PDMS lift-off patterning technique, and Figure 1c shows the molecular diagrams of the device constituents. When the sample is optically excited with a λ=408 nm light source, emission from both the unpatterned (λ~630 nm) and patterned areas (λ~655 nm) is observed, as seen in Figure 2. The background emission dominates since its cavity resonance is closer to the resonance of DCM, as shown; use of different organic materials with larger lift-off amounts can increase this wavelength shift.



**FIGURE 1:** (a) Patterned microcavity structure. (b) The PDMS lift-off patterning process. (c) Molecular structures of constituent materials.



**FIGURE 2:** Emission spectrum of DCM with unpatterned (background) and patterned microcavities when excited with λ=408 nm.

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