Organic photonic devices by soft nanopatterning on active materials and nanofluids

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Methods for nanopatterning active materials and nanocomposites on surfaces play a fundamental role in the fabrication of functional devices. In organic nano- and optoelectronics, a current challenging issue is the research of cheap, parallel-patterning approaches for fabricating addressable matrix arrangements of spatially discrete elements, and high-quality emissive features with sub-100 nm size, to be employed as nanoscale light sources. In this frame, high-resolution soft lithographic technologies are able to fulfill these requirements, and particularly approaches based on nanofluidic transport of molecules. Recently, researchers began to investigate the potential of fluidics at the 10–100 nm scale because of its unequalled manipulation, separation, and delivery accuracy at molecular scale, and due to the availability of flexible lithographic techniques for fabricating structures with sub-micrometer resolution.

We report on our results demonstrating (i) nanofluidics as sub-100 nm technology for building emissive organic nanofeatures with precise control of their cross-section and spatial arrangement, and (ii) nanopatterning of materials composite at nanoscale, made by nanoparticles and polymers. We realise emissive arrays and optically active dots and fibers with lateral dimensions of features down to a few tens of nanometers. Moreover, vertically moving nanofluids can be exploited to overcome hard polymer transport in materials incorporating nanocrystals. Rheology, fluorescence, quantum yield, and emission directionality of the nanostructures are investigated. The obtained results open new perspectives for the realization of light-sources for nanophotonics, based on hybrid organic-inorganic systems by combining nanofluidic and optoelectronic materials properties.