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ABSTRACT

Nanostructuring Organic Materials into Complex Light Sources

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Complex light sources with controlled broadband emission and intensity, adjustable spatial and temporal coherence are of increasing interest in many applications, including optical sensing and communication, lighting and display technologies. Laser emission in disordered systems relies on multiple scattering in the heterogeneous materials, rather than on an external cavity, to select the optical modes. To this aim, various complex architectures can be fabricated with organic materials providing stimulated emission over broad wavelength ranges, by exploiting different fabrication strategies to obtain the functional nanostructures of choice. Examples include organic hybrid heterostructures and networks of nanofibers and nanowires [1], which can be designed with variable degree of complexity and flexibility, and realized by means of relatively simple, low-cost technological processes.
In this work, we review the manufacturing technologies and methods developed in our group to produce complex laser systems with unique functional properties. The first investigated system was based on nanowires and nanofibers, arranged either in either 3-dimensional or planar networks and made by electrospinning [2]. The optical gain properties were varied in the whole visible range, whereas the light scattering properties were effectively tailored through network topologies and fiber size and composition, enabling tunable random lasing. In another approach, organic light-emitting heterostructures

were obtained by combining dry–wet transient materials, that is a red-emitting polymer bi-layer onto a nonpolar cyclic hydrocarbon sublimating substrate [3]. Such systems feature physically-transient properties and can undergo functional changes which may include programmable decomposition. Applications of these results might include full-field speckle-free imaging, disposable light sources for lab-on-chip platforms, and environmental sensors.

References

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