Functional polymer nanofibers

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1D nanostructuring of organic materials is gaining continuous research interest, and polymer nanofibers, as building blocks of complex architectures, can lead to advances in many fields including photonics and electronics. In particular, electrospun polymer nanofibers exhibit smart physico-chemical properties, with a large variety of possible applications. The interest on this class of materials mainly relies on their peculiar high surface to volume ratio, large area coverage, and availability of low-cost production technologies. In particular, the electrospinning method, which is based on the uniaxial elongation of a jet from the surface of a charged polymer solution in presence of an intense electric field, is a versatile and high-throughput technique enabling the fabrication of fully organic, inorganic and hybrid nanofibers.

Properly designed functional nanofibers capable of sensing, storing and converting energy have been demonstrated. Mechanical flexibility, ease of processing, good chemical resistance and large sensitive areas are some of the properties associated to such novel materials. This in turn enables the exploitation of deformations induced by small forces through pressure, mechanical vibration, elongation/compression, as natural sources of power. Other interesting perspectives for devices in nanophotonics have been opened by the enhanced optical properties of electrospun nanofibers. Light-emitting polymer nanofibers can be building blocks of miniaturized integrated photonic systems, where a single fiber can work as either incoherent or coherent source, and waveguide. In addition, by exploiting the peculiar nanofiber geometry, novel geometries are to be demonstrated for organic lasers based on single nanofibers and on their ensembles.

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References

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