Published in the "Electrospinning for High Performance Sensing" EHPS 2014 International Workshop
Book of Abstracts, 29-30.04.2014. ISBN: 978-88-6224-012-3

ELECTROSPUN NANOFIBERS FOR PHOTONIC AND OPTICAL SENSING APPLICATIONS

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Electrospinning (ES) is a technologically mature approach for the fabrication and production of polymeric, inorganic and composite nanofibers. This technology allows macroscopic quantities of nanomaterials to be produced, finding application in diverse fields including filtration, tissue engineering and electronics. The ES technique is attracting also a growing interest for the industrial upscaling potentialities of the process [1]. Recently, ES has been also utilized for the fabrication of optically active nanofibers, suitable for photonic and optoelectronic applications [2], where electrospun fibers can be used as light sources, waveguides, sensors and light detectors. Optically active nanofibers can be realized by using both transparent polymers, doped with low-molar-mass active molecules or inorganic quantum dots and semiconducting polymers (Figure 1). Most of the reported electrospun nanofibers made by luminescent or active compounds show improved optical properties, polarization properties, waveguiding and lasing properties [2], compared to the bulk counterpart. For photonic applications, the requirements for the fiber production are often tight, since the propagation of light in a fiber with submicron size (often wavelength scale size) can be adversely affected by a non uniform shape and/or composition of the fiber. This is particularly important for the exploitation of the optically active fibers as optical sensors [3], where the propagation and/or interaction of light with the nanofibers has to be properly managed in order to improve the performance of the sensing active unit. To this aim, different approaches have been proposed for controlling both the fiber shape and positioning, allowing emissive electrospun fibers with diameters as low as 180 nm to be obtained [4] and the positioning of individual electrospun fibers to be controlled with micrometer spatial resolution [5].

Here, our recent results on the optical properties of active electrospun polymer nanofibers will be reviewed. Different approaches have been developed for the electrospinning luminescent and active nanofibers with variable size, shape and macroscopic assembly. Absorption, polarized spatial- and time-resolved photoluminescence, infrared and Raman spectroscopies have been employed to investigate the optical features of light-emitting fibers. In particular the potential application of electrospun nanofibers for photonic and optical sensing will be presented.

Acknowledgments. The research leading to these results has received funding from the European Research Council under the European Union's Seventh Framework Programme (FP/2007-2013)/ERC Grant Agreement n. 306357 (ERC Starting Grant "NANO-JETS"). We also acknowledge the Apulia Regional Projects 'Networks of Public Research Laboratories' WAFITECH (09) and M. I. T. T. (13).

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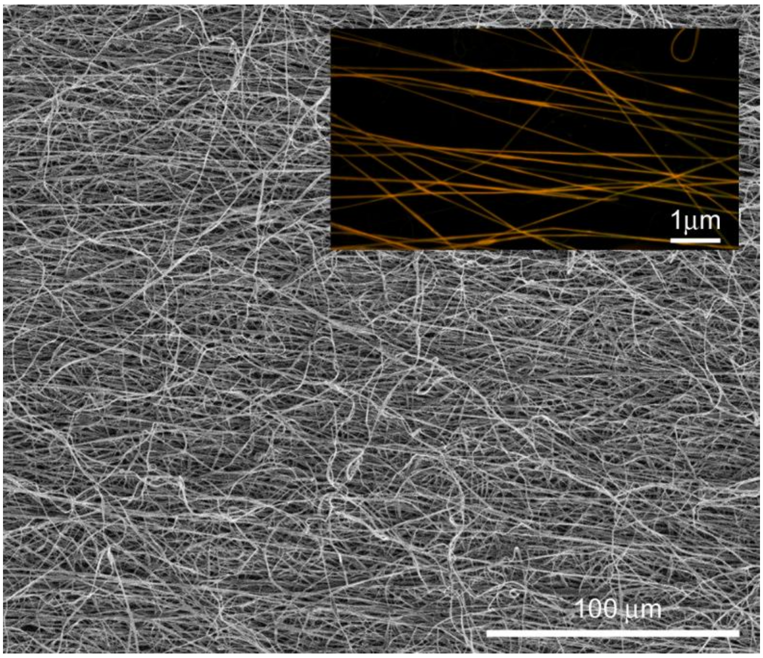

Figure 1. Example of a scanning electron microscopy (SEM) image of electrospun nanofibers made by a conjugated polymer. Inset: fluorescence micrograph of light-emitting nanofibers, obtained by confocal laser scanning microscopy.

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