University-Industry cooperation. Functional elctrospun polymeric nanofibers: from nanohybrid to bioactive materials

Maria Letizia FOCARETE - SpinBOW S.r.l., University of Bologna

Electrospun nanofibers have emerged as good candidates for numerous applications in diversified fields. The possibility to process, through electrospinning, long and continuous fibers with the incorporation of different functionalities has importantly widened the spectrum of application of electrospun materials. Functional electrospun polymeric products can be obtained in different ways, going from the use of polymers with intrinsic functionalities to the addition into the fibers of other components (inorganic fillers, nanoparticles, functional molecules, etc.), to multiscale hierarchical scaffolds for tissue regeneration. In this presentation, some examples of these methods will be described. The first approach makes use of materials (homopolymers, copolymers or blends) with intrinsic functionality. As an example, electrospun fibres made of mechanochromic polymers, which are stimuli-responsive materials capable of changing their optical properties when subjected to a mechanical force, will be presented 1 . The mechanochromic response of these nanofibers, as filler in a composite material made of PDMS, showed fast reversibility upon force unloading, allowing the detection of directional stress and strain to obtain mechanically responsive materials. Polyester-based copolymers can be designed in terms of composition, molecular architecture and phase distribution, in order to show tunable functional properties, as well as shape memory behavior. Different biocompatible polymers were electrospun, and the shape memory behaviour, as well as the potential of the obtained scaffolds for skeletal regeneration, was investigated. The incorporation of bioactive glasses into shape memory fibers to develop a biomimetic, bioactive and shape-programmable osteogenic scaffold, using a benign solvent for the electrospinning process will also be presented. For the fabrication of nanohybrid polymeric–inorganic nanofibers with advanced functionalities, electrospinning was also used in combination with additional specific synthetic and processing procedures. As an example, “reactive sol- gel electrospinning” was performed to electrospin organic-inorganic hybrid fibers developing highly porous non-woven membranes to be used as separators with improved performances compared to commercial ones. Other examples of nanohybrid fibres will be presented, such as a multiscale composite material made of electrospun nanofibrous mat sandwiched in a hydrogel enriched with well-dispersed tantalum nanoparticles as an osteoinductive component, or the development of 3D-polymeric electrospun scaffolds with a multiscale structure mimicking the hierarchical morphology and mechanical properties of native tendons.