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TITLE

Control over the spatial distribution of additives in and on electrospun polymer nano/microfibers

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Electrospinning is a popular means of generating polymers fibers with controlled diameters measuring from nanometers to micrometers, depending on material properties and process conditions. In this technique, electrostatic forces resulting from an electric field overcome the surface tension of a polymer solution and produce a fine liquid jet that travels toward an oppositely charged target. During the time of flight, solvent evaporates, and the jet solidifies as the polymer crystallizes or vitrifies. While such nano/microfibers inherently possess a high surface-to-volume ratio, they become more attractive when they are functionalized. Two scenarios are presented in this vein. The first addresses the addition of a bioorganic oligomer with a tailored peptide sequence to the polymer solution prior to electrospinning. The electric field responsible for electrospinning forces the oligomer to migrate to the fiber surface during solidification, generating biofunctionalized nano/microfibers in a single step. In the second scenario, three methods are introduced to control the spatial distribution of, and in some instances align, surface-functionalized nanoparticles in electrospun nano/microfibers. The first employs a simultaneously applied magnetic field to align magnetic nanoparticles on-demand, which influences the magnetic moment of the nanoparticles. The second relies on the flow field induced during electrospinning to align gold nanorods at nanoscale dimensions. The nano/microfibers are further aligned to yield a multiscale strategy for the development of materials used in biomedical imaging. Lastly, electrospinning immiscible polymers yields biphasic nano/microfibers, and the resultant morphology can be used to control the spatial distribution of added nanoparticles that selectively reside in one phase.

Biography

Spontak received his Ph.D. from the University of California at Berkeley and pursued post-doctoral research at Cambridge University before joining the Procter & Gamble Company and, later, NC State. His research interests relate to the phase behavior and morphology/property development of nanostructured polymers, polymer nanocomposites, electron microscopy and organogels. He is the recipient of the 2006 ACS Cooperative Research Award, the 2007 Ernst Ruska Prize, the 2008 ACS Chemistry of Thermoplastic Elastomers Award, and the 2011 Colwyn Medal. He has published over 250 research papers, and his work has been featured on the cover of 17 journals and 1 book.