

# Superhydrophobic surfaces by electrospinning of polymer mixtures

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Hydrophobic surfaces have found great interest in environment resist coating, antifouling marine structures and low friction devices whereas superhydrophobic materials, with contact angle higher than 150° [1], are of special interest in self-cleaning surfaces and stain resistant textiles. (Super)hydrophobicity is a key property that depends on both the surface chemistry and surface roughness. Numerous methods were reported for the preparation of superhydrophobic surfaces by either increasing the surface roughness of an inherently hydrophobic material or decreasing the surface free energy of a rough surface by post-treatment [1]. For instance, controlled crystallization [1], lithography [1], etching [1] were reported in the literature for the production of such surfaces. Nevertheless, all these techniques suffer from some drawback such as high cost, time consuming and expensive processes. As an alternative approach, electrospinning was proposed for the production of superhydrophobic surfaces with controlled roughness, morphology and/or porosity. For instance, Acatay et Al. reported on the preparation of electrospun fibers starting from a poly(AN-co-TMI)/fluorolink-D mixture followed by the annealing of these material in order to enable the reorientation of the perfluorinated groups to the solid-air interface [2]. Rutledge et al. described the preparation of superhydrophobic surfaces by combining electrospinning of PCL and initiated chemical vapor deposition of perfluoroalkyl ethyl methacrylate [3]. Allcock et al. prepared superhydrophobic nanofibers by electrospinning of an organic-soluble poly[bis(2,2,2-trifluoroethoxy)phosphazene] [4]. In order to simplify the experimental protocols described in the literature on the preparation of superhydrophobic surfaces and decrease the cost related to the use of pure fluoropolymers, electrospinning of homopolymer/semifluorinated diblock copolymer mixture, i.e. a polyisobornylacrylate/poly(isobornyl acrylate-b-heptadecafluorodecyl acrylate) mixture, onto aluminum plates is proposed in this study. In practice, a diblock copolymer based on 1H,1H,2H,2H heptadecafluorodecyl acrylate and isobornyl acrylate was prepared by RAFT polymerization. In a second step, electrospinning of PIBA/PAC8-b-PIBA mixtures of different compositions was investigated. At high fluorine content ([PIBA]/[PAC8-b-PIBA] = 50/50), the electrospun mats show high surface roughness (microparticles of undefined morphologies) and a superhydrophobic character. By decreasing the fluorine content, the morphology of the films changed from particles to beaded fibers ([PIBA]/[PAC8-b-PIBA] = 70/30) or fibers ([PIBA]/[PAC8-b-PIBA] = 85/15), which is consistent with an increase of the solution viscosity, but the surfaces still demonstrate or tend to superhydrophobicity.

(1) X.-M. Li, D. Reinhoudt, M. Crego-Calama, What Do We Need for a Superhydrophobic Surface? A Review on the Recent Progress in the Preparation of Superhydrophobic Surfaces, *Chem. Soc. Rev.*, 36, 1350 (2007).

(2) K. Acatay, E. Simsek, C. Ow-Yang Y. Menciloglu; Tunable, Superhydrophobically Stable Polymeric Surfaces by Electrospinning, *Angew. Chem. Int. Ed.*, 43, 5210 (2004).

(3) M. Ma, Y. Mao, M. Gupta, K. Gleason, G. Rutledge, Superhydrophobic Fabrics Produced by Electrospinning and Chemical Vapor Deposition, *Macromolecules*, 38, 9742 (2005).

(4) A. Singh, L. Steely, H. Allcock, Poly[bis(2,2,2-trifluoroethoxy)phosphazene] Superhydrophobic Nanofibers, *Langmuir*, 21 (25), 11604 (2005).