Stevens Institute of Technology

Nanotechnology Graduate Program

CONTINUOUS ELECTROSPINNING OF POLYMER NANOFIBERS USING AN AFM TIP

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Electrospinning uses electrostatic forces to shape polymers into micro- and nanofibers. Recently the field has been reinvented due to an expanding number of applications that range from filtration to tissue engineering. The electrospinning possess many desireable properties, such as a high surface-to-volume ratio and an interconnected three-dimensional porous network that makes them very versatile in many areas of materials science. Recently, Nylon-6 and Poly(ethylene oxide) (PEO) nanofibers were successfully fabricated using an atomic force microscopy probe (AFM) as an electrospinning tip. The nanometer-size tip enabled controlled deposition of uniform polymeric nanofibers within a 1 cm diameter area. Nylon-6 and PEO nanofibers were continuously electrospun at a solution concentration as low as 1 wt% Nylon-6 in HFIP and 5 wt% PEO in a 50:50 (v/v) water/ethanol solvent mixture. Results indicate significant morphological and microstructural differences in the case of AFM based electrospinning, due to the role of surface charges and the enhanced electric field strength. Electrospun Nylon 6 fibers display predominantly γ crystalline form; however WAXD and DSC results show a small but significant decrease in crystallinity and crystallite size, demonstrating the effect of process dynamics on crystallization and solvent evaporation. Similar observations in the case of AFM-spun PEO were also made. Applications to bone tissue engineering and cancer drug testing will be highlighted.

John F. Rabolt is the Karl W. and Renate Boer Professor and Founding-Chair of the Department of Materials Science and Engineering at the University of Delaware, where he is also an Associated Faculty in the Delaware Biotechnology Institute. Before joining Delaware in 1996, Professor Rabolt was a Research Staff Member (1977-96) at the IBM Almaden Research Center where he served as Co-Director of the NSF Center on Polymer Interfaces and Macromolecular Assemblies (CPIMA), a Stanford/IBM/UC-Davis Materials Research Science and Engineering Center. His research interests lie in the area of polymer deformation and orientation, electrospinning, organic thin films, IR/Raman spectroscopy and biomolecular materials for tissue engineering. Rabolt received the 2008 New York Society of Applied Spectroscopy's Gold Medal. He has previously received the 2005 Pittsburgh Spectroscopy Award, the Bomem-Michelson Award in Molecular Spectroscopy in 2000, the 1993 Ellis Lippincott Award in Vibrational Spectroscopy, the 1992 Louis A. Strait Award in Applied Spectroscopy, the 1990 Williams-Wright Award in Molecular Spectroscopy and the 1985 Coblentz Award. Rabolt is a Fellow of the American Physical Society (APS) and also served as an Associate Editor of the ACS Journal MACROMOLECULES from 1992-2001. He recently (1997-2003) served as a member of the Gordon Research Conference's Scheduling and Selection Committee and was a recent member of NASA's Microgravity Materials Science Advisory Committee. Professor Rabolt has co-authored more than 200 peer-reviewed publications, 1 book and 10 patents.

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