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Solvay Seminars in Macromolecular Science & Engineering

Macromolecules Innovation Institute (MII)

VIRGINIA TECH

Prof. Julie Kornfield

"Multiplicity of Morphologies"

California Institute of Technology
Professor
Department of Chemical Engineering

Host: Michael Schulz

Abstract: Poly(L-lactide), PLLA, is the structural material of the first clinically approved bioresorbable vascular scaffold (BVS), a promising alternative to permanent metal stents for treatment of coronary heart disease. BVSs are transient implants that support the occluded artery for 6 months, and are completely resorbed in 2 years. Clinical trials of BVSs report restoration of arterial vasomotion and elimination of serious complications such as Late Stent Thrombosis. It is remarkable that a scaffold made from PLLA, known as a brittle polymer, does not fracture when crimped onto a balloon catheter or during deployment in the artery. We used x-ray microdiffraction to discover how PLLA acquired ductile character and found that the crimping process creates localized regions of extreme anisotropy; PLLA chains in the scaffold change orientation from the hoop direction to the radial direction on micron-scale distances. This multiplicity of morphologies in the crimped scaffold works in tandem to enable a low-stress response during deployment, which avoids fracture of the PLLA hoops and leaves them with the strength needed to support the artery. Thus, the transformations of the semicrystalline PLLA microstructure during crimping explain the unexpected strength and ductility of the current BVS and point the way to thinner resorbable scaffolds in the future.

California Institute of Technology
Chemical Engineering
Pasadena, CA, 91125
Phone: 626-395-4138
E-mail: jak@cheme.caltech.edu

Bio: **Julie A. Kornfield**, Professor of Chemical Engineering at the California Institute of Technology, is an expert in polymer science, particularly how polymers influence and are influenced by flow. She has applied small angle neutron and x-ray scattering to diverse systems, including end-associative polymers for aviation safety and security (Wei *et al*., *Science* 2015), flow-induced crystallization of polymers (e.g., *Science* 2007) and the effects of flow on polymer self-assembly (e.g., *Science* 1997). Since she joined the Caltech faculty in 1990, Kornfield has received the Dillon Medal of the American Physical Society, been elected Fellow of the American Physical Society and the American Association for the Advancement of Science, and received the Bingham Medal of the Society of Rheology. Her work spans from fundamental research on the molecular basis of polymer structure and properties, to commercialization of polymers that improve health and safety.

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