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Non-continuum, anisotropic nanomechanics of random and aligned electrospun nanofiber matrices DAPHNEY CHERY, BIAO HAN, Drexel University, ROBERT MAUCK, VIVEK SHENOY, University of Pennsylvania, LIN HAN, Drexel University — Polymer nanofiber assemblies are widely used in cell culture and tissue engineering, while their nanomechanical characteristics have received little attention. In this study, to understand their nanoscale structure-mechanics relations, nanofibers of polycaprolactone (PCL) and poly(vinyl alcohol) (PVA) were fabricated via electrospinning, and tested via AFM-nanoindentation with a microspherical tip (R$\approx$10μm) in PBS. For the hydrophobic, less-swollen PCL, a novel, non-continuum linear F-D dependence was observed, instead of the typical Hertzian F-D$^{3/2}$ behavior, which is usually expected for continuum materials. This linear trend is likely resulted from the tensile stretch of a few individual nanofibers as they were indented in the normal plane. In contrast, for the hydrophilic, highly swollen PVA, the observed typical Hertzian response indicates the dominance of localized deformation within each nanofiber, which had swollen to become hydrogels. Furthermore, for both matrices, aligned fibers showed significantly higher stiffness than random fibers. These results provide a fundamental basis on the nanomechanics of biomaterials for specialized applications in cell phenotype and tissue repair.

Daphney Chery
Drexel Univ

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