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Nanoscale Mechanics of Type I Collagen H. HARPER, E. CROPPER[1], A. BULGER, U. CHOKSI, T.J. KOOB, S. PANDIT, W.G. MATTHEWS, University of South Florida — Collagen is the most abundant protein in the body by mass. Type I collagen fibrils provide mechanical strength and cellular housing within tissues exhibiting a broad range of mechanical properties. This diversity in the mechanics of tissues with similar underlying components warrants detailed study of the process by which structure and mechanics develop. While collagen mechanics have been studied at the tissue level for decades, surprising little is known about collagen mechanics at the fibril and molecular level. Presented herein is a multi-scale experimental and computational investigation of collagen I mechanics, bridging the single molecule and fibril hierarchal forms. The mechanics of single collagen molecules are explored using AFM and force spectroscopy. Moreover, atomistic molecular-dynamics simulations are performed to provide structural information not accessible to the experimental system. Fibrils then are grown from molecular collagen, and the mechanics of these fibrils are investigated using AFM. Based upon the single molecule and fibril results, a coarse-grain computational model is being developed. The outcomes include a better understanding of how the mechanics of filamentous self-organizing systems are derived and how their hierarchical forms are established.

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