Interpenetrating Polymer Network Hydrogels with Multiple Local Stiffnesses

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Cells sense and respond to the mechanical properties of the extracellular matrix (ECM) at different time and length scales. Synthetic interpenetrating networks (IPNs) can be used to mimic the natural structures of ECM[1-3]. In this project, IPNs with independently crosslinked “soft” and “rigid” networks are prepared by using star-PEG/poly(ethylene-glycol diacrylate) mixtures through free radical polymerization and orthogonal polymerization methods. The macroscopic properties of IPNs are investigated, for example, water uptake and elasticity of swollen hydrogels. The local mechanical properties of the individual network can be controlled by the polymerization degree, the star-arm number and length, as well as the crosslink degree of both networks. High-resolution atomic force microscopy (AFM) is used to study the local mechanical property of the IPNs. The two networks are functionalized individually with different ligands, chemically functionalized AFM tip is used, for example, streptavidin-biotin complex. Cell behaviors on IPNs presenting both soft and stiff networks are individually modified with cell adhesive ligands are investigated, for example, cell spreading, focal adhesion, and stress fibers formation and maturation. We hypothesize that IPN architectures can present a variety of different mechanical signals at cellular mechanosensing levels.

[1] W. T.S. Huck et al., Nat. Mater. 11, 642 (2012).
[2] A. del Campo & A. J. García et al., Nat. Mater. 14, 352 (2015).
[3] J. P. Spatz et al., J. Cell Sci. 125, 3765 (2012).