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Mechanotunable protein networks with switchable biological activities

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Materials scientists can learn a great deal from the mechanisms whereby cells construct their own environment. Recent studies have shown that cell-matrix interaction is regulated not only by the specific multi-protein composition of the matrix but also by its mechanical properties. These studies demonstrated that adhesion-mediated signaling and the subsequent molecular interactions at the cytoplasmic faces of adhesion sites can be switched on or off by mechanical stress. The mechanisms underlying the transduction of mechanochemical and structural information via the protein networks of the extracellular matrix are poorly understood, yet a detailed understanding of such a system can lead to the development of new design principles for cellular environments and the elucidation of adhesion-mediated signaling principles. The goal of this proposal is to engineer new materials consisting of fibronectin, collagen or mixed fibronectin/collagen networks that can be switched to different functional states regarding cell regulation by mechanical force. The proposed research is the first attempt to design and construct mechanically tunable adhesive matrices with synthetic/biological hybrid building blocks resulting in a material that actively modulates cell functions by changing their adhesive and signaling properties.

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