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Three-dimensional soft tunable platforms for control of cell-matrix interactions (I)

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The extracellular matrix (ECM), a complex network of proteins including collagen (COL) and fibronectin (FN) couples a cell with its environment and directly regulates the cell's fate via physical and biochemical signals. Although the ECM was often considered a static structure providing cohesion and mechanical integrity to tissues, it has recently been shown that (i) the nano-structure, (ii) the nano/micro mechanics, and (iii) the signaling capacity of the ECM are affected by cell-generated forces. Our work has focused on investigating and controlling the material properties of ECM networks and the synergistic roles of FN and COL in 3D environments. In a first example, I will show how the integrated method used in our lab allows us to diagnose early dysregulation of the ECM materials properties in tumors. In a second example, I will present 3D matrix-mimicking polymeric platforms we developed to control both COL and FN properties over macroscopic volumes. These platforms enable a better understanding of the critical link between protein structure and function, with the ultimate goal of controlling cellular functions through cell-matrix interactions. As such, they represent a new tool for biological research with many potential applications in basic research, medical diagnostics, and tissue engineering.

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