‘STRAIN STIFFENING’ THE KEY TO BIOMIMETIC CYTOSKELETAL MATERIALS

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ABSTRACT

Cell fate is a coordinated response caused by biomechanical and biochemical interactions with the extracellular matrix (ECM). Numerous synthetic gels have been developed as mimics of the extracellular matrix, in the hope of understanding how cells respond to the mechanical properties of the tissue microenvironment, with the goal being to develop a fully synthetic extracellular matrix for regenerative medicine applications. In contrast to all synthetic gels developed to date, the extracellular matrix proteins such as collagen type I, and fibrin, display nonlinear mechanical properties such as strain stiffening and negative normal stress [1]. In these materials the elastic modulus of the gel increases by several orders of magnitude as the applied strain increases such that the resistance that a cell feels is strongly depended of the strain that it applies. In this presentation I will demonstrate the unique cytomimetic properties of hydrogels based on oligo(ethylene glycol) grafted polyisocyanopeptides [2]. These extremely stiff helical polymers [3] form gels upon ***warming*** at concentrations as low as 0.005 %-wt polymer, with materials properties almost identical to these of intermediate filaments and extracellular matrices. The macroscopic behaviour of these gels can be described in terms of the molecular properties of the basic stiff helical polymer and a multi-step hierarchical self-assembly, which results in strain stiffening [4]. The unique ability of these materials and their application in cell growth and drug therapeutics will be discussed.

References:

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