

Encoding “Living” Bioactivity in Biomaterials

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Great advances in the fields of self-assembly, nanoscience, and supramolecular chemistry over the past two decades have now established emerging new directions for the design of soft matter with dynamic behavior that emulates living systems. Supramolecular assemblies with filamentous architecture found in extracellular matrices and in the cytosol signal cells from their external environment and also mediate from within many of their functions. These highly dynamic structures are the scaffolds of extracellular biological signals and the mediators of development and regeneration. This lecture will describe supramolecular biomaterials built from assemblies of peptides, nucleic acids, glycans, and biopolymers that mimic structural and dynamic aspects of natural tissue components. The lecture will also discuss their great capacity to promote musculoskeletal and neural regeneration, and their living-like bioactivity. The highly dynamic behavior of these supramolecular biomaterials will be illustrated with systems that can adapt structurally to bind proteins, create reversible superstructures that control cell behavior, guide maturation of induced pluripotent stem cells, and signal cells with dynamic bioactivity by switching signals “on” or “off” as observed in biological systems.