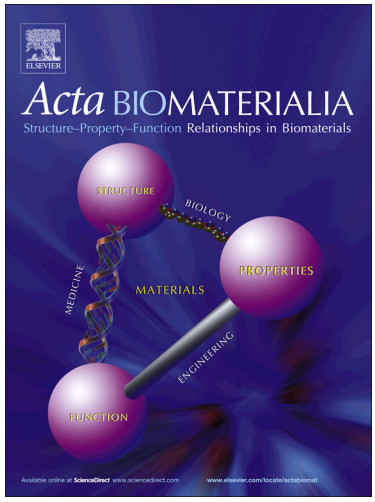

Full length article

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Rational Design of Charged Peptides that Self-Assemble into Robust Nanofibers as Immune-Functional Scaffolds

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Abstract

Self-assembling peptides programed by sequence design to form predefined nanostructures are useful for a variety of biomedical applications. However, assemblies of classic ionic self-complementary peptides are unstable in neutral pH, while charged peptide hydrogels have low mechanical strength. Here, we report on the rational design of a self-assembling peptide system with optimized charge distribution and density for bioscaffold development. Our designer peptides employs a sequence pattern that undergoes salt triggered self-assembly into β-sheet rich cationic nanofibers in the full pH range (pH 0 to 14). Our peptides form nanofibrils in physiological condition at a minimum concentration that is significantly lower than has been reported for self-assembly of comparable peptides. The robust fiber-forming ability of our peptides results in the rapid formation of hydrogels in physiological conditions with strong mechanical strength. Moreover, fiber structure is maintained even upon dense conjugation with a model bioactive cargo $OVA_{257-264}$ peptide. Nanofibers carrying $OVA_{257-264}$ significantly enhanced $CD8^+$ T cell activation in vitro. Subcutaneous immunization of our peptide fiber vaccine also elicited robust $CD8^+$ T cell activation and proliferation in vivo. Our self-assembling peptides are expected to provide a versatile platform to construct diverse biomaterials.

Key Words: self-assembly, peptide, nanofiber, hydrogel, scaffold