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Molecular self-assembly of tissue engineering matrices

Using a rational design approach, we have implemented a novel class of self-assembling, peptide-based, hydrogel scaffolds with the unique advantages of biologic specificity, hydrolytic degradability and the ability to incorporate cells. Hydrogel scaffolds with biologic specificity have increasingly been explored for use in tissue engineering and regenerative medicine, particularly those that can both self-assemble and mimic the biological features of extracellular matrix. Molecularly engineered structures provide control over cell and tissue behavior that is not possible with traditional polymers. This type of bottom-up approach may serve as a model for the design and optimization of hydrogel scaffolds with relevant bioactivity for use in tissue engineering. The molecules of interest for this work are self-assembling depsipeptides (DPs), also known as ester amides. Our system makes use of two molecular regions: a hydrophobic tail to control assembly and a hydrophilic depsipeptide oligomer which confers biologic activity and degradability. These molecules can self-assemble into different ordered structures including nanoparticles and fibrous, hydrogel scaffolds. The side chains can be varied among a wide range of chemical groups, resulting in a family of molecules with a host of possible bioactivities. Our group has been focused on depsipeptides where the chemical backbone consists of ester substitutions along the backbone of a peptide oligomer. This class of materials may confer certain advantages of peptide mimics while allowing for hydrolytic degradability. The current work reports the synthesis of depsipeptide analogs of the canonical Arginine-Glycine-Aspartic acid (RGD) sequence, a ubiquitous amino acid motif known to bind cell integrins to mediate cell adhesion and interaction with the extracellular matrix (ECM). Our results demonstrate the potential of depsipeptides as the basis for self-assembling hydrogel materials with biological function and controlled hydrolytic degradation.

Biography

Laura J Suggs earned her Undergraduate degrees from the University of Texas at Austin and her PhD in Chemical Engineering with concentration in Biomaterials and Tissue Engineering from Rice University in 1998. Following a Research Associate position at the University of Minnesota, she returned to Texas to join as the Faculty of The University of Texas at Austin in 2004. She has been the recipient of numerous awards including: American Heart Association Beginning Grant-in-Aid and Grant-in-Aid; NSF ADVANCE Fellowship; NSF CAREER award and recent election to the American Institute for Medical and Biologic Engineering. She is a Full Professor and the Associate Chair of the Biomedical Engineering Department at UT Austin. She has served as an Editor for Annals of Biomedical Engineering and the Journal of Materials Chemistry, part B, as well as serving on numerous scientific and advisory boards.

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