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EECS Seminar Series

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"Materials Science, Biology and Medicine Intersect in the Real World of Tissue Engineering: The Case of Mending a Heart"

Tuesday, February 24, 2009 • 4:00 p.m. • Harris Center (HEC) 101

Tissue engineering and the closely related field of regenerative medicine have the potential to greatly impact medicine within the next 10 years, and certainly through the 21st century. Tissue engineering uses ideas in materials science, chemistry, biology, medicine and engineering to grow living tissues and organs for repair or replacement of damaged and diseased tissues and organs. Tissue engineering is closely related to regenerative medicine and is often considered a fast pathway for early clinical successes in regenerative medicine. Successful tissue engineering demands facilitated and structured collaboration between basic scientists, applied scientists, engineers, clinicians, and industry. For tissue engineering to become a standard tool in clinical medicine, a number for foundation issues must be addressed. These foundations are: angiogenesis, innervation, surgical integration, appropriate biomechanics, inflammation/healing, cell sources and market realities. This talk will briefly overview these issues and then demonstrate how materials can contribute to tissue engineering via porous scaffolds.

Porous polymeric scaffolds for tissue engineering serve to provide anatomical shape to the implant/repair, attach cells, direct cell growth/differentiation and finally provide an environment for tissue formation. Ultimately, they must biodegrade and leave behind functional tissue. In this talk, a number of scaffold technologies will be addressed, along with the biomaterials that they are fabricated from. A central question in engineering scaffolds is what pore sizes, pore shape, pore orientation and interconnectivity is best for tissue engineering. Though definitive answers to these questions are not yet available, some contemporary thinking on this subject will be discussed. A special focus in this talk will be on a porous material made by sphere templating. These sphere-templated scaffolds, that have every pore the same size and highly interconnected, rapidly induce angiogenesis and minimize fibrotic outcomes. A special variant of this material will have long, parallel pores for heart muscle cells and spherical pores to induce angiogenesis.

Polymers used for tissue engineering have been largely those from the lactic acid/glycolic acid polyester families (PLA/PGA). PLA/PGA type polymers are not elastomeric, are difficult to bio-functionalize and degrade to produce strongly acidic products. Improved biodegradable synthetic polymers are needed and will see application in tissue engineering scaffolds, drug release systems and medical devices. This presentation will introduce two novel strategies for creating biodegradable polymers particularly aimed at tissue engineering applications. A poly (hydroxyethyl methacrylate) gel that is biodegradable through precision-integrated polycaprolactone oligomers will be presented. Also, a new class of polymers using amino acid anhydrides as the biodegradable unit will be described.

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