MSE 520: SEMINAR SERIES

MATERIALS SCIENCE & ENGINEERING | WINTER 2017

JANUARY 30, 2017 | MUELLER 153 | RECEPTION: 3:30 PM LECTURE 4:00 PM

Immune Modulatory Biomaterials for Cell-based Therapies

Immune cell recognition of implanted biomedical devices initiate a cascade of inflammatory events that result in collagenous encapsulation of implanted materials which leads to device failure. These adverse outcomes emphasize the critical need for biomaterials that do not elicit foreign body responses. One prime example for the use of this technology is with the development of a bioartificial pancreas for the treatment of patients suffering from diabetes. Immunoisolation of insulin producing cells with porous biomaterials provide an immune barrier that is a potentially viable treatment strategy for Type1 diabetic patients. However, clinical implementation has been challenging due to host immune responses to implanted materials. To address this challenge, we have focused our efforts on the development of improved biomaterials for the use in pancreatic islet cell transplantation.

To enable the discovery of novel superbiocompatible biomaterials we have developed a high throughput pipeline for the synthesis and evaluation of >1000 material formulations and prototype devices. Here, we describe combinatorial methods we have developed for covalent chemical modification and in vivo evaluation of alginate based hydrogels. Using these methods, we have created and screened the first large library of hydrogels, and identified leads that are able to resist foreign body reactions in both rodents and nonhuman primates. These formulations have been used to generate optimized porous alginate hydrogels fabricated with tuned geometries to enhance biocompatibility. We have identified a lead alginate derivative and capsule formulation geometry that shows minimal recognition by macrophages and other immune cells, and almost no visible fibrous deposition in rodents, and up to at least six months in nonhuman primates. Significantly, our lead formulation has enabled us to achieve the first long term glycemic correction of a diabetic, immune competent animal model with human embryonic stem-cell derived islet cells, encapsulated using our novel superbiocompatible, chemically modified alginate formulation.

Professor Omid Veiseh

Assistant Professor, Bioengineering // CPRIT Scholar in Cancer Research

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Dr. Omid Veiseh is an Assistant Professor and CPRIT Scholar in Cancer Research in the Department of Bioengineering at Rice University. His laboratory utilizes advanced nano-, micro-, and macro- fabrication techniques in combination with molecular engineering and cellular and molecular biology, to develop platforms of implantable devices tailored for in vivo chemical sensing and delivery of therapeutics. Dr. Veiseh received a dual Ph.D. in Materials Science, Engineering and Nanotechnology from the University of Washington working in the laboratory of Prof. Miqin Zhang. He completed his postdoctoral research with Prof. Robert Langer and Prof. Daniel Anderson at Koch Institute for Integrative Cancer Research at MIT and Harvard Medical School. Over the course of his career he has authored, or co-authored more than 50 peer-reviewed publications including those in Nature, Nature Biotechnology, Nature Materials, Nature Medicine, Nature Reviews Drug Discovery, and is an inventor on 20 pending or awarded patents, many of which have been licensed for commercialization by 3 separate biotechnology companies. He has received numerous awards and fellowships including: NSF Integrative Graduate Education and Research Training (IGERT) Fellowship, NIH T32 Ruth L. Kirschstein National Research Service Award Postdoctoral Fellowship, Juvenile Diabetes Research Foundation Postdoctoral Fellowship, DOD/CDMRP Breast Cancer Research Program Postdoctoral Fellowship, and DOD/CDMRP Visionary Postdoctoral Fellowship, a Young Investigator Award from the Arthritis National Research Foundation (ANRF), and most recently, he awarded a $2 million CPRIT Scholar In Cancer Research Award from state of Texas.

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