Chemical Engineering Distinguished Young Scholars Seminar

Immune Modulatory Biomaterials for Cell-Based Therapies

Omid Veiseh
Postdoctoral Fellow
Massachusetts Institute of Technology

Date: Monday, August 10, 2015
Time: Lecture: 4:00-5:00 p.m.
Place: PAA A110
Happy Hour in Benson Hall Lobby

Abstract

Host recognition and subsequent foreign body responses are a series of immune mediated reactions that impact the performance of implanted biomedical devices. Immune cell recognition of biomaterial surfaces initiate a cascade of inflammatory events that result in the fibrous and collagenous encapsulation of implanted materials. Over time, this encapsulation can lead to device failure and great discomfort for the recipient. These adverse outcomes emphasize the critical need for biomaterials that do not elicit foreign body responses so that we are able to overcome this key challenge with long-term biomedical device functionality. 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 Type-1 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. In my talk I will 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 non-human 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.

Bio

Dr. Omid Veiseh is a Postdoctoral Fellow at the Massachusetts Institute of Technology. Working in the laboratory of Institute Professor Robert Langer and under the co-mentorship of Professor Daniel G. Anderson, his research is aimed at developing superbiocompatible hydrogels for immunoisolation of pancreatic islet cells. He obtained his Bachelors of Science degree in Cell Biology from Western Washington University, and a Dual Ph.D. in Materials Science & Engineering and Nanotechnology from the University of Washington. Dr. Veiseh has contributed to more than 40 peer-reviewed research publications, and is an inventor on 12 pending or awarded patents. Three separate biotechnology companies have licensed technologies invented by Dr. Veiseh for commercialization. Throughout his career, 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, and most recently, a Young Investigator Award from the Arthritis National Research Foundation (ANRF).