Chemical Engineering & Materials Science

UNIVERSITY OF MINNESOTA

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Contact Information

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Education

B.S., Chemical Engineering, Massachusetts Institute of Technology, 2006
Ph.D., Chemical Engineering, University of Wisconsin-Madison, 2011
Postdoctoral Fellow, Chemical and Biological Engineering, Northwestern University, 2012-2014

Research Areas

Biological Engineering

Research Interests

The goal of our research program is to elucidate the mechanisms underlying cellular dormancy and activation, which has broad implications in translational applications such as mobilizing endogenous stem cells for regenerative therapies and targeting cancer therapeutics toward maintaining dormancy of disseminated tumor cells. Our research focuses on two areas: 1) activation of endogenous cardiac stem cells for heart repair, and 2) development of therapeutic strategies to prevent recurrence of metastatic breast cancer.

Regenerative Medicine: Given their capacity for self-renewal and differentiation to many cell types, stem cells have been utilized in various tissue engineering applications. One promising application of stem cell-based tissue repair is treatment of cardiovascular disease, which is responsible for 1 out of every 3 deaths in the United States. Heart failure is often caused by the irreversible loss of cardiomyocytes, and while some cell transplantation strategies have shown promise in improving cardiac function following injury, there are still many challenges involved, including survival, maturation and efficient functional integration of transplanted cells. Our group aims to develop bio-instructive scaffolds that provide the necessary mechanical and chemical signals to promote heart repair through activation of endogenous stem cell populations within the organ.

Cancer Therapeutics: Cancer mortality typically results from metastasis of the primary tumor to other organs. Though metastasis is often thought of as a late stage in tumor progression, recent studies have shown that tumor cells can widely disseminate very early, even in the pre-invasive disease stage, and can stay dormant at various sites in the body for many years before reactivating. Relapse of metastatic disease following long periods of dormancy is particularly common in breast cancer, which is a leading cause of death for women. We utilize biomaterial scaffolds to engineer metastatic niches in vivo in order to elucidate mechanisms regulating tumor cell dormancy and develop novel therapeutic strategies for controlling disseminated cells and preventing disease

recurrence.

Awards

Baxter Young Investigator Award, 2013
National Science Foundation Graduate Research Fellowship, 2007-2010
Ronald A. Ragatz Outstanding Teaching Assistant Award, 2008
Interdisciplinary Stem Cell Fellowship, UW-Madison Regenerative Medicine and Stem Cell Cluster, 2007

Selected Publications

Gower R.M., Boehler R.M., Azarin S.M., Ricci C.F., Leonard J.N., and Shea L.D. “Modulation of leukocyte infiltration and phenotype in microporous tissue engineering scaffolds via vector induced IL-10 expression.” Biomaterials. 35, 2024-2031 (2014).

Lian X., Zhang J., Azarin S.M., Zhu K., Hazeltine L.B., Bao X., Hsiao C., Kamp T.J., and Palecek S.P. “Directed cardiomyocyte differentiation from human pluripotent stem cells by modulating Wnt/Î2-catenin signaling under fully defined conditions.” Nat. Protoc. 8, 162-175 (2013).

Lippmann E.S.*, Azarin S.M.*, Kay J.E., Nessler R.A., Wilson H.K., Palecek S.P., and Shusta E.V. “Human blood-brain barrier endothelial cells derived from pluripotent stem cells.” Nat. Biotechnol. 30, 783-791 (2012). (*Equal contributions)

Lian X., Hsiao C., Wilson G., Zhu K., Hazeltine L.B., Azarin S.M., Raval K.K., Zhang J., Kamp T.J., and Palecek S.P. “Robust cardiomyocyte differentiation from human pluripotent stem cells via temporal modulation of canonical Wnt signaling.” Proc. Natl. Acad. Sci USA. 109, E1848-57 (2012).

Azarin S.M., Larson E.A., Almodovar J.M., de Pablo J.J., and Palecek S.P. “Effects of 3-D microwell culture on growth and metabolism of human embryonic stem cells.” Biotechnol. Appl. Biochem. 59, 88-96 (2012).

Azarin S.M., Lian X., Larson E.A., Mielke H.M., de Pablo J.J., and Palecek S.P. “Modulation of Wnt/Î2-catenin signaling in human embryonic stem cells using a 3-D microwell array.” Biomaterials. 33, 2041-2049 (2012).

Broderick A.H., Azarin S.M., Buck M.E., Palecek S.P., and Lynn D.M. “Fabrication and selective functionalization of amine-reactive polymer multilayers on topographically patterned microwell cell culture arrays.” Biomacromolecules. 12, 1998-2007 (2011).

Azarin S.M., and Palecek S.P. “Development of scalable culture systems for human embryonic stem cells.” Biochem. Eng. J. 48, 378-384 (2010).

Mohr J.C., Zhang J., Azarin S.M., Soerens A.G., de Pablo J.J., Thomson J.A., Lyons G.E., Palecek S.P., and Kamp T.J. “The microwell control of embryoid body size in order to regulate cardiac differentiation of human embryonic stem cells.” Biomaterials. 31, 1885-1893 (2010).

Metallo C.M., Azarin S.M., Moses L.E., Ji L., de Pablo J.J., and Palecek S.P. “Human embryonic stem cell-derived keratinocytes exhibit an epidermal transcription program and undergo epithelial morphogenesis in engineered tissue constructs.” Tissue Eng. Part A. 16, 213-223 (2010).

Wood K.C., Azarin S.M., Arap W., Pasqualini R., Langer R., and Hammond P.T. “Tumor-targeted gene delivery using molecularly engineered hybrid polymers functionalized with a tumor- homing peptide.” Bioconjug. Chem. 19, 403-405 (2008).