COLLEGE OF ENGINEERING

Research Seminar Series

University of Nebraska-Lincoln
Department of Chemical and Biomolecular Engineering

# Simple and Robust Strategies for Biomanufacturing of Cardiac Cells from Human Pluripotent Stem Cells


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*Host: Dr. Yuguo Lei*


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10:00 a.m. – 11:00 a.m.
Othmer Hall Room 205
**Refreshments provided*

## Abstract


Stem cells process numerous cues in their environment in making discrete fate choices, including differentiation to specialized cell types. Immobilized extracellular matrix cues, soluble signals, cell-cell communication and mechanical signals have all been shown to affect self-renewal and differentiation. Realization of the scientific and therapeutic potential of stem cells requires the ability to reliable produce large quantities of high quality cells by controlling stem cell differentiation in vitro. While developmental biology provides a template for designing differentiation processes, recapitulation of the environment in a developing organ in a bioreactor may be too complex to be effective. I will discuss examples that illustrate how precise temporal orchestration of a small number of developmental pathways using soluble factors can guide human pluripotent stem cell (hPSC) differentiation to various cardiac lineages. For example, we have identified canonical Wnt signaling as a key regulator of cardiomyocyte differentiation and designed a protocol that produces high purity cardiomyocytes in a defined, xeno-free, growth factor-free system via appropriate temporal presentation of small molecule modulators of Wnt signaling. Furthermore, we have determined that specific canonical Wnt activation and inhibition profiles combined with TGFb superfamily or VEGF ligands can direct hPSCs to vascular endothelial progenitors, epicardial cells, cardiac fibroblasts, smooth muscle cells, and endocardial cells in defined processes. I will also discuss the challenges of quality control in monitoring differentiation and maturation states of hPSC-derived cardiovascular cells via marker expression and phenotypes. Thus, by stage-specific modulation of signaling pathways that regulate heart development in vivo, we can generate hPSC-derived cardiac cells for in vitro studies, drug screening and toxicology analyses, and development of regenerative therapies.


## Biography

Sean Palecek is the Milton J. and Maude Shoemaker Professor and Vilas Distinguished Achievement Professor in the Department of Chemical & Biological Engineering at the University of Wisconsin – Madison. Sean's lab studies how human pluripotent stem cells (hPSCs) sense and respond to microenvironmental cues in making fate choices, with a focus on differentiation to cardiovascular lineages. Sean's lab has generated novel mechanistic insight and developed protocols for differentiation of hPSCs to cardiovascular and neurovascular cell types. They strive to engineer fully-defined, animal component-free differentiation platforms, compatible with biomanufacturing of cells for *in vitro* and *in vivo* applications.

Sean's recent awards include the Cozzarelli Prize of the National Academy of Sciences and the Biotechnology Progress Excellence in Research Publication Award for his work on cardiovascular tissue manufacturing from hPSCs. Sean is the Bioengineering Thrust Leader for the UW Stem Cell and Regenerative Medicine Center and the Associate Director for Research for the National Science Foundation funded Center for Cell Manufacturing Technologies.