

***PhD in Biomedical Sciences
Dissertation Defense***

Presents a Seminar Titled:

“New Tools for Real-Time Study of Embryonic Development”



Presented By

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Embryonic development represents one of the most complex and dynamic cellular processes in biology, and plays vital roles in understanding of functions of embryonic stem cells (ESCs) and design of ESC-based therapy. Conventional methods cannot effectively provide spatial and temporal resolutions with sufficient sensitivity and selectivity that are required to depict embryonic development *in vivo* in real-time at single-cell and single-molecule resolutions. In this dissertation, we have developed a wide range of innovative tools for real-time study of embryonic development. These new tools include biocompatible and photostable plasmonic gold (Au) and silver (Ag) nanoparticle (NP) imaging probes, dark-field optical microscopy and spectroscopy (DFOMS), and ultrashort electric pulses. We have designed and synthesized a mini-library of Au and Ag NPs with different sizes and chemical properties. We have used developing zebrafish embryos as *in vivo* model organisms to study embryonic development and as *in vivo* assays to study size- and chemical-dependent nanotoxicity. We found that these multicolored imaging probes can passively diffuse into embryos and enter into embryos non-invasively. These NPs exhibit superior photostability and enable us to study embryonic environments for a desired period of time. Our studies show that Au NPs are much more biocompatible than Ag NPs, while Ag NPs are much more sensitive and colorful than Au NPs. Furthermore, Ag NPs can incite stage-specific embryonic phenotypes, and enable us to generate distinctive mutants for further identification of biomarkers for better understanding of embryonic development and for potential diagnosis of birth defects. We have developed new methods to effectively culture and sustain ESCs of zebrafish, mouse and human, laying down the foundation for real-time study of differentiation of ESCs both *in vitro* and *in vivo* for a wide variety of biomedical applications.

Friday, October 18, 2013 at 12:30 in ECSB, (The Cave)