THE OHIO STATE UNIVERSITY
INSTITUTE FOR MATERIALS RESEARCH

Spring 2016 IMR Facility Grants Awards

Five new research projects were awarded by the IMR for a total investment of $10,000 in nascent materials research. The five projects support eight researchers from four different departments within the College of Engineering and College of Arts and Sciences.

Developing Nonlinear MEMS

Hanna Cho, Mechanical and Aerospace Engineering

The main objective of this project is to build nonlinear MEMS enabling a full control of mechanical resonance by manipulating structural nonlinearity. The successful completion of this project is potentially enhancing the sensing capability of current MEMS significantly and, accordingly, its practicality.

A Correlative Study of the Skyrmion Phase Diagram for FeGe Thin Films

Sarah Dunsiger, Physics and Center for Emergent Materials; Co-Investigator: Robert Williams, Center for Electron Microscopy and Analysis

Chiral magnetic materials which exhibit so-called skyrmion phases have been of increasing interest, due to their potential relevance for energy efficient magnetic storage and computation. From transport measurements, the presence of a skyrmion lattice has been reported in thin film FeGe grown on (111) Si over a broad range of thicknesses and temperatures up to 278K, where the introduction of interfaces stabilizes the skyrmion phase compared to the bulk compound. The proposed project seeks to image skyrmions in thin films using aberration corrected Lorentz transmission electron microscopy (LTEM) at cryogenic temperatures and varying applied magnetic fields. This study will allow the phase diagram of FeGe thin films to be mapped and the presence of skyrmions to be directly verified in real space.

Atomic Scale Chemical Ordering and Structural Distortion in High Entropy Alloys

Maryam Ghazisaeidi, Materials Science and Engineering; Co-Investigator: Jinwoo Hwang, Materials Science and Engineering

We propose to determine the atomic scale chemical ordering and lattice distortion in HfZrTaNb-based high entropy alloys using a combination of advanced computational simulations and quantitative imaging techniques in scanning transmission electron microscopy. The support from the IMR Facility grant is requested for the use of FEI Titan microscope at the Center for Electron Microscopy and Analysis. The support would enable the acquisition of preliminary data that will greatly help enhance our near-future grant proposals to the external funding opportunities.

Quantifying cell-matrix remodeling during angiogenesis in a microfluidic vessel bifurcation system

Jonathan Song, Mechanical and Aerospace Engineering; Co-Investigator: Shaurya Prakash, Mechanical and Aerospace Engineering

Blood vessels are perfusable tubes lined with endothelial cells (ECs) and supported by a surrounding extracellular matrix (ECM). The vascular system is comprised of an interconnected and hierarchical network of branching or bifurcating blood vessels where this network expands through a coordinated process of EC proliferation, migration, and ECM remodeling known as sprouting angiogenesis. Yet, it remains poorly understood how the fluid mechanical conditions that arise at vessel bifurcations, namely impinging stagnation point flow and slowly moving interstitial flow through the supporting 3-D ECM, help initiate angiogenesis and support sprout elongation. To address this important question, we developed a novel microfluidic model of angiogenesis at bifurcation point (MMABP) that mimics both the flow conditions and cell/matrix architecture of bifurcating blood vessels. We will combine this approach with confocal reflectance microscopy to assess cell- matrix remodeling to ascertain a directional bias for sprout elongation and ECM fiber alignment in relation to the direction of interstitial flow at vessel bifurcations.

Selective Electrohydrodynamic Deposition (SED) for Creating 3D Hybrid Microstructures

Yi Zhao, Biomedical Engineering

This project is to investigate a selective electrohydrodynamic deposition (SED) process of multiphase capillary flow for creating three-dimensional (3D) hybrid microstructures with high spatial resolutions and controlled geometries, where the microstructures are composed of one or more types of multiphase particles that are sized a few microns down to 100 nm. In the so-called SED process, each multiphase particle has a core-shell structure. The core and the shell are made of different materials to deliver unique properties and functions. The SED process will be used to expand such unique properties and functions at single particle scale to affect the behaviors of larger-scale systems.