Winter 2012 IMR Facility Grants

Awarded by the OSU Institute for Materials Research (IMR)

Seven new research projects were awarded by the IMR in December 2012, for a total investment of $14,000 in nascent materials research. The seven projects support faculty researchers from five different departments within the College of Engineering, the Division of Natural and Mathematical Sciences and the College of Dentistry.

Analysis of Matrix Mineralization by Analytical Electron Microscopy

Gunjan Agarwal, Biomedical Engineering; Co-Investigator: David W McComb, Materials Science and Engineering

This project aims to employ analytical electron microscopy techniques to understand how collagen fiber structure affects sub-cellular, intra and extra-fibrillar mineralization in bone tissue. These results will be complemented with micro-CT analysis of bone tissue to quantify the overall bone-mineral density at the micro and macro scale.

Using High Resolution Characterization Techniques to Date and Authenticate Ancient Metallic Objects

William Clark, Materials Science & Engineering

This grant will provide funds for instrument time for a pilot study that addresses a major challenge for art historians and conservators, namely the determination of the age and origin of metallic objects. This study will employ the most advanced characterization methods, with the objective of validating the proposal that a set of microstructural parameters can be used for systematic dating. The instrument time that the funds will provide will be sufficient to demonstrate the applicability of this approach, and will form the basis for a full research proposal to NSF.

Development of Organic-based Materials and Their Applications

Arthur J. Epstein, Physics

The Epstein Group is established as the world leader in organic-based magnetism and organic-based spintronics. Two key pillars of the program for developing novel materials for organic spintronics and understanding the device physics/promoting device performance are to: (1) Explore thin films of organic-based magnets with novel formulations and processing techniques.

(2) Study the performance of spin injection by using different process techniques. The IMR Facility Grant is expected to enhance these projects by utilizing the IMR facilities which are very important for characterizing the morphology of these materials and devices and providing key information.

Multifunctional Nanospheres and Microspheres to Control Cardiac Wound Healing

Jianjun Guan, Materials Science and Engineering

The objective of this proposal is to create multifunctional microspheres and nanospheres to efficiently control wound healing process in the heart following heart attack (also called myocardial infarction (MI)). The purpose of this work is to prevent already damaged hearts from progressing to heart failure, an end stage heart disease with extremely high mortality. The proposed studies will have broader impacts on the treatment of tissue degeneration and fibrosis.

Correlating Nanoscale Composition with Mechanical Properties of Bone

David W McComb, Materials Science and Engineering; Co-Investigator: Do-Gyoon Kim, College of Dentistry, Orthodontics

Mechanical properties of bone at the tissue level can determine a mechanical behavior of bone at the organ level. While the composition of bone tissue controls the mechanical properties of bone tissue, a lack of knowledge exists about the direct relationship between them. By analyzing the composition of at nanoindentation sites we will directly correlate composition and mechanical properties.

Nanowire and Nanorod Growth in Ambiently-Dried TiO_2 Aerogel Films

Patricia A. Morris, Materials Science & Engineering

The objective of this project is to create new TiO2 nanostructures derived from ambiently-dried titania aerogel films. Aerogels are high-surface area oxide network structures with a continuous open porosity ideal for applications such as dye-sensitized solar cells (DSSCs) and potentiometric gas sensors. Exposure to varying gaseous environments at elevated temperatures has been found to modify the TiO2 aerogel structure by two or more competing mechanisms. Gold nanoparticles have seeded the growth of TiO2 nanowires in some samples, while similarly-sized nanorod structures have been found to grow intrinsically in these conditions without the need for gold nanoparticles. By analyzing the mechanisms for growth, different structures could be grown preferentially from these aerogel films to optimize their performance based on the device applications dictated by external funding agencies.

Imaging of Gel Phantoms for Instrument Development for Characterizing Cancer Tissue

Shaurya Prakash, Mechanical and Aerospace Engineering; Co-Investigator: Vishwanath Subramaniam, Mechanical and Aerospace Engineering

Dynamic imaging of gel phantoms mimicking tissue samples will be conducted to elucidate fundamental mechanisms of water and ion transport leading to observed differences in the characteristics of eddy currents in cancer-bearing and normal tissue. The fundamental studies will be used to generate data for proposals to a variety of federal funding sources.