Spring 2011 Facility Grants
Awarded by the OSU Institute for Materials Research (IMR)

Seven new research projects were awarded by the IMR in April 2011, for a total investment of $14,000. The seven projects support the research work of faculty from eight departments within the College of Engineering, College of Pharmacy, and the Division of Natural and Mathematical Sciences.

High Throughput Production of Multi-Component Multi-Layered Acetalated Dextran-based Microparticle for Vaccination Applications

Lead Investigator: Kristy Ainslie, Division of Pharmaceutics, College of Pharmacy; Co-Investigators: Barbara Wyslouzil, Chemical and Biomolecular Engineering, Sadhana Sharma, Research Scientist, Division of Pharmaceutics

To facilitate production scale-up and improve vaccine efficacy we propose the use of electrospray drying for fabrication of multi-layered microparticles encapsulating protein and small molecules. These microparticles will be fabricated from the novel polymer Acetalated Dextran (Ac-DEX) which has shown enhanced immune activity compared to traditional biopolymers. Processing parameters (e.g. flow rate, concentration) will be varied to optimize protein and drug loading of the electrosprayed microparticles.

Nanostructured Metal Surfaces for Electrocatalytic Chemical Conversion

Lead Investigator: Anne Co, Chemistry

Nanostructured metals are ideal electrode materials for advanced electrical energy storage and conversion devices. The ability to control surface and bulk structures of electrode materials is key to manipulating catalysts reactivity. In this work, our goal is to control surface structures by depositing highly ordered metal adlayers, and to develop a systematic method for studying surface structure effects on reactivity and reaction mechanism.

Direct Writing and Infusion of Bioactive Molecules for Guided Microvessel Formation

Lead Investigator: John Lannutti, Materials Science and Engineering; Co-Investigators: Dave Farson, Materials Science and Engineering; Heather Powell, Materials Science and Engineering

This project seeks to combine polymer scaffold fabrication technology, femtosecond laser patterning and sub-critical CO2 infusion to develop a functional microvascular network within a 3D scaffold to provide a structural and nutritional support to the islets during and after implantation. Diabetes affects 23.6 million Americans at an annual medical cost of over $174 billion. Islet transplantation has emerged as an important surgical component of diabetes treatment. However, a majority of islet recipients do not remain insulin independent over a 5-year time frame. Islet transplantation often fails due to disruption of the microvascular network and destruction of the islet microenvironment during isolation. Tissue scaffolds that both provide an appropriate physical environment for adhesion/growth and direct *in vitro* microvessel network formation would be a critical advance for biomedicine.

Polymer-based Flexible and Stretchable RF Electronics

Lead Investigator: John Volakis, Electrical and Computer Engineering; Co-Investigator: Lanlin Zhang, Postdoctoral Researcher, Electroscience Lab

This project focuses on the development of a new class of flexible and stretchable RF electronics. These electronics rely on the successful deposition of RF circuits on polymer-based dielectrics. Although polymers have the highly desirable properties of being stretchable and flexible, their metallization to form RF circuits is very challenging. This is due to the poor adhesion properties of polymer substrates. However, our recent research showed that thin Cu conductors can be directly deposited reliably onto polymer substrates using a modified state-of-art microfabrication process. Our process is expected to greatly improve the electrical and mechanical performance of the printed RF circuits by optimizing fabrication protocols.

Silicon Carbide Cryogenic Neutron Damage Testing

Lead Investigator: Wolfgang Windl, Materials Science and Engineering; Co-Investigator: Thomas Blue, Mechanical and Aerospace Engineering

This project proposes to fabricate Hall bars to investigate the effect of neutron irradiation on the carrier mobility in SiC at cryogenic temperatures. Besides the relevance of the results for the performance of electronics in the radiation field of an outer-space environment, we want to test the hypothesis that the irradiation of materials at low temperatures and low radiation fluence may simulate the results of a high radiation fluence experiment, due to the low target material temperature locking in the radiation-induced damage. If low-fluence-low-temperature results can be correlated to high-fluence-high-temperature environments, this will open up a wide range of opportunities to study irradiation effect problems that are currently outside of the capabilities of the OSU Research Reactor Lab and most other reactor labs; decrease the cost of further neutron testing of SiC and other devices; and advance understanding of the neutron damage and crystal defect annealing processes.

Device Physics and Characterization of $LaAlO_3/SrTiO_3$ 2DEG Fabricated by Ultra-High Vacuum Sputtering

Lead Investigator: Fengyuan Yang, Physics; Co-Investigator: Siddharth Rajan, Electrical and Computer Engineering

This project proposes the deposition of $LaAlO_3$ epitaxial films on $SrTiO_3$ using ultra-high vacuum (UHV) sputtering for the study of device physics and characterization of complex oxide two-dimensional electron gas (2DEG)-based novel electronic devices. The team comprises complementary expertise in the epitaxial film growth of complex oxides using UHV sputtering (Yang) and semiconductor device fabrication and characterization (Rajan). Using state-of-the-art UHV sputter technique, we have demonstrated the growth of complex oxide epitaxial films such as $BiFeO_3$ and the $A_2BB'O_6$ double perovskites that rival the quality of semiconductor epitaxial films. Our technique should produce similar or higher quality films of $LaAlO_3$, which is a less complex than double perovskites.

Polymeric Artificial Compound Eye for Advanced Endoscopic Imaging

Lead Investigator: Yi Zhao, Biomedical Engineering

This project proposes to develop a polymeric optical component, the key structure in the proposed artificial compound eye imaging system. The component with an adaptive focus length will implement three-dimensional image acquisition with a wide field of view. The long term goal of the research is to develop an advanced artificial compound eye system that can present three-dimensional, wide field-of-view and high definition images to improve the medical outcome of endoscopy procedures by fabricating a smart microfluidic system which combines the advantages of both the compound eye of insects and the camera eye of mammalians.