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Center for Integrated Bio & Nano Systems

Director:
Dr. Dmitri Litvinov, Electrical & Computer Engineering and Chemical & Biomolecular Engineering

Associate Director:
Dr. Richard Willson, Chemical & Biomolecular Engineering and Biochemical & Biophysical Sciences

Members:
Drs. Jiming Bao, Stanko Brankovic, Fritz Claydon, Dmitri Litvinov, Paul Ruchhoeft, Electrical & Computer Engineering
Dr. Gila Stein, Richard Willson, Chemical & Biomolecular Engineering
Dr. T. Randall Lee, Chemistry

Affiliated Faculty:
Dr. A. Bensaoula, Physics, Electrical & Computer Engineering
Dr. A. Ignatiev, Physics, Chemistry, Electrical & Computer Engineering
Dr. D. Luss, Chemical & Biomolecular Engineering
Dr. D. Stokes, Physics
Dr. L. Sun, Mechanical Engineering

Website:
www.uh.edu/ibns/

Over the past couple of years, the Center for Integrated Bio and Nano Systems had two significant developments. First, the center (formerly the Center for Nanomagnetic Systems) was renamed to reflect evolutionary developments in the center’s research program that go beyond what is covered under the
nanomagnetics umbrella. And second, the center welcomed Jiming Bao, an assistant professor of electrical and computer engineering, who specializes in nanophotonics and photonic crystals research.

Among some of the projects taken on during the year included a collaboration by professors Richard Willson and Paul Ruchhoeft with researchers at both the Texas Medical Branch (UTMB) and the Baylor College of Medicine to develop ultra-sensitive, point-of-care diagnostic tools using micro-retroreflectors. What those researchers have discovered is the reflectivity of such reflectors, when fabricated at the micron scale, can drop significantly when small quantities of bacteria or virus particles link opaque nanoparticles to the reflector surface. These changes can be observed with low-cost optics and grants from the Western Regional Center of Excellence for Biodefense and Emerging Infectious Diseases. The NIH Center at UTMB has awarded more than $2.4 million to integrate this technology with modern microfluidics devices to create a low-cost sensor capable of using patient symptoms probe for a large variety of diseases.

In addition, professors Stanko Brankovic and Dmitri Litvinov collaborated with researchers from Seagate Technology and Arizona State University to study the magnetoresistance of the nanocontacts made of the novel phase-separated ferromagnetic metal-metal oxide/hydroxide nanomaterials. The approach is to build, test and study prototype nanocontact devices having different and well characterized material structures. These devices will be built using a bottom-up fabrication scheme while nanocontact structures vary from single crystal nickel or iron to the nanocontact with ferromagnetic matrix with a certain fraction of metal-oxide/hydroxide phase. This research addresses the feasibility of ferromagnetic metal-metal oxide/hydroxide nanomaterials synthesized in the nanoelectrode geometry configuration as a novel approach for fabrication of magnetic field sensors. This project will establish the fundamental relationship between the size and material structure of ferromagnetic nanocontacts and their magnetoresistance.

This research program represents a multidisciplinary effort which has a large transformative potential for development of future magnetic field sensors for magnetic recording, magnetic imaging, spintronics and magnetic biosensor technologies. The new knowledge created in this project will be incorporated into undergraduate and graduate nanotechnology and nanofabrication courses at the University of Houston, which will become a part of the broad educational outreach through the Electrochemical Society's short course.

This work will also provide the training for three doctoral students and for several high school teachers and undergraduate students involved in summer research programs sponsored by the National Science Foundation. Students involved in this project will have a chance to get training and to work in an industrial research environment through internships provided by Seagate Technology.