FAU Lands U.S. Department of Defense Grant for Powerful Imaging Tool

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Florida Atlantic University has received a $599,503 grant from the United States Department of Defense for a powerful high resolution imaging technique that can reveal nanoscale structures. The Transmission Electron Microscopy enables multidisciplinary research in the materials and life science fields and includes a scanning unit, an EDS detector for elemental analysis and a tomography holder for 3D visualization of nanostructures.

The acquisition of the Transmission Electron Microscopy is a joint effort across six colleges and institutes at FAU including the College of Engineering and Computer Science, the Charles E. Schmidt College of Science, the Schmidt College of Medicine, Harbor Branch Oceanographic Institute, the Harriet L. Wilkes Honors College, and the College of Education. FAU's research efforts related to the grant will include nanocomposites, bio-inspired materials, nanoparticles, wearable sensors, drug development and delivery, bone tissue regeneration, biofilms, biomedical microelectromechanical systems and stem cell-matrix interactions.

"Nanoscale imaging capabilities will not only ensure rapid progress in our current Department of Defense-funded materials research, but also will stimulate research in relevant areas such as biomedical engineering, marine biotechnology, sensing and threat detection as well as nanotechnology," said Vivian Merk, Ph.D., principal investigator and an assistant professor in FAU's Department of Ocean and Mechanical Engineering, College of Engineering and Computer Science, and Department of Chemistry and Biochemistry, Charles E. Schmidt College of Science. "Due to its great versatility, this research equipment will be critical in a variety of our research projects and will significantly contribute to the success of FAU's long-term research and STEM education goals."

Transmission Electron Microscopy is essential for studying the micro- and nanostructure of

inorganic, organic and hybrid materials. In inorganic samples, the instrument reveals the orientation and internal structure of crystal lattices down to individual atoms, as well as defects, such as dislocations or grain boundaries. Transmission Electron Microscopy is the preferred method to directly measure the size, grain size, size distribution, and morphology of nanomaterials. The technology also provides direct structural information on soft matter, including synthetic polymers, macromolecules or organic fibers. The imaging technique reveals the ultrastructure of biological systems in fine details.

Research using this instrumentation will deepen knowledge about cellular uptake mechanisms that play a key role in drug delivery and will prove useful for studying complex interfaces in highly mineralized tissues such as enamel or bone for improved bone regeneration and tissue engineering. In recent years, scientists have made significant strides in understanding the underlying mechanisms of interface failure, crack propagation, nanoparticle dispersion, and particle/polymer interaction. An integral part of this research is identifying mechanisms responsible for failure and aging. Utilization of the Transmission Electron Microscopy, in combination with macroscopic testing, will help FAU researchers better identify the best strategies for long-term material protection and reinforcement.

“Electron microscopy has become an indispensable tool in areas important to national defense, such as physical sciences, engineering and biomedicine,” said Stella Batalama, Ph.D., dean, FAU College of Engineering and Computer Science. “We are excited to house this cutting-edge instrumentation in our college, which will be integrated into research training to augment our existing capabilities in research areas of interest for the Department of Defense. In addition, we are developing course curricula for K-12 education to attract students in underrepresented institutions to pursue studies leading to STEM careers.”

Prior Department of Defense-sponsored materials research at FAU involves the development of flexible body armor and polymer matrix composites with outstanding mechanical and chemical stability. Nanoscale imaging capabilities will not only ensure rapid progress in this research, but also stimulate new research areas such as air revitalization in submarines, drug development and delivery, bone tissue engineering, sensing and threat detection, and nanotechnology. This instrumentation will further contribute to the development of new therapeutic tools and disease interventions.

As part of the grant, outreach efforts will encompass a number of initiatives, including structured student visits to the Transmission Electron Microscopy lab, internships for selected schoolteachers, or the development of a Nanoscale Imaging teaching module. Electron microscopy will be integrated into the undergraduate STEM curriculum to promote active learning and student engagement in the classroom. FAU's Office of Undergraduate Research and Inquiry will support talented undergraduate students to work on Transmission Electron Microscopy-related projects under the leadership of a faculty mentor.

"Transmission Electron Microscopy is of great importance as it can stimulate students' interest and motivation for studying science and technology by establishing a meaningful connection between the classroom and the real word," said Merk.

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