RESHAPING THE WORLD BY UNDERSTANDING AND ENGINEERING NANOSTRUCTURES

By AMP Staff

The development of instruments to observe the atomic structures in atomic and molecular level has changed the science and development of the materials forever. The properties of these materials depend not just on the structure of the substance, but also the size of the same atomic combinations which changes its properties in nano-scale size.

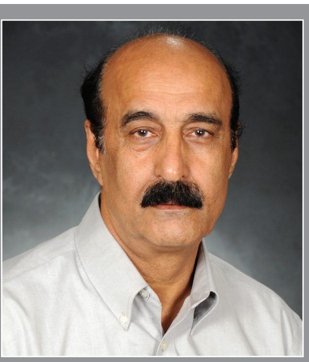
Arkansas Research Alliance Fellow Dr. Mansour Mortazavi, vice chancellor of research, innovation and economic development and a professor of quantum optics at the University of Arkansas at Pine Bluff, is leading a team of Arkansas researchers in a quantum-foundry research project funded by the National Science Foundation. The team includes Dr. Hugh Churchill, physics professor at the University of Arkansas, and Dr. Sanjay Behura, chemistry and physics professor at UA-Pine Bluff.

The project, the MonArk Quantum Foundry, is led by Montana State University and the University of Arkansas. Its mission is to accelerate two-dimensional (2D) materials research for quantum computing in the United States. UAPB's inclusion into the project offers an opportunity to both broaden participation within the MonArk ecosystem and provide crucial pathways toward new markets for quantum photonic products, benefitting Arkansas' economic growth. This alliance is expected to strengthen research of quantum 2D materials and integrated photonics at UAPB and will significantly expand quantum career-path opportunities for UAPB students.

Arkansas team members are working on two specific goals — expanding the way 2D material research is conducted and how it applies to quantum computing, and the development of new materials for lasers and detectors working in the mid-infrared region of the spectrum, which are used in a wide range of applications including medicine, communications and defense.

At first glance, there is not much substance to a nanoscopic 2D material. The diminutive material is named for only two dimensions: length and breadth. Its third dimension, height, is negligibly small. As it turns out, hosting a "negligibly small" dimension is a hugely beneficial aspect, one that is reshaping industries like solar energy and quantum computing.

"In a 2D material, charge carriers [a mobile electron or hole by which an electric charge passes through a semiconductor] are confined only in two dimensions, implying unique electrical and optical properties," Behura said. "Owing to the atomically thin structure and unique properties, the 2D materials play important roles in building quantum information science [QIS] technologies such as quantum computers, quantum networks and quantum sensors."



Dr. Mansour Mortazavi

Dr. Sanjay Behura

Behura and his team at UAPB work to synthesize quantum materials and discover new structures with on-demand properties by stacking, twisting and wrapping one material onto another. They then study these engineered structures to develop next-generation solar cells and advanced quantum technologies.

The advancement of quantum computing is an ongoing mission of UAPB research, and 2D materials have already contributed to the development of next-generation solar cells. The research ultimately results in enhanced optical absorption and high-charge carrier transport, which Behura and his students believe will be transformational in 2D materials-based photovoltaic energy conversion.

"Our team's advances in solar energy research and the collaboration with MonArk speaks volumes to UAPB's growing capabilities in quantum optics physics," Mortazavi said. "We look to recruit and foster more post-doctoral researchers, undergraduate students and graduate students to the project, which means more intellectual capital invested here in Arkansas."

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