Enhanced energy: Team seeks more powerful electronic devices

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Groundbreaking energy research from the United Arab Emirates, sponsored by the Office of Naval Research Global (ONRG), is the focus of an article published this week in the Nature Magazine journal *Scientific Reports*.

Dr. Ammar Nayfeh's article reveals unique use of zinc oxide (ZnO) to improve semiconductors and energy output in electronic devices. The research could have enormous benefits not only for Marines in forward operating bases and Sailors at sea, but also for a global population of consumers eager to see increased capability and faster performance from their electronic devices.

"This is an excellent example of expanding the Naval Research Enterprise's network to ensure we are capitalizing on the high-quality, novel research that is being conducted across the globe," said Capt. Clark Troyer, ONRG's commanding officer. "Dr. Nayfeh's team at Masdar Institute of Science and Technology [Abu Dhabi, UAE] has demonstrated new ways to increase efficiency in solar cells and photodetectors—research which could be pivotal in reducing our dependency on both fuel and battery resupply for the warfighters."

ONR Global is ONR's international arm for basic research sponsorships outside of the U.S., working with researchers and partners around the world to discover and advance research that will benefit U.S. naval forces. ONRG's science directors promote collaboration with international scientists through research grants.

Dr. Nayfeh's partnership with ONRG began during a visit from the science director responsible for ONRG projects in the Middle East and North Africa, Dr. Monique Beaudoin.

"There is a growing capacity in academic institutions in the Gulf region for hypothesis-driven, basic research in support of renewable energy initiatives in the countries of the region," said Beaudoin. "This project highlights some of that research. In parallel, Gulf countries like the UAE are aiming to move toward knowledge-based economies—in fact, Dr. Nayfeh's lab has a strong contingent of graduate students from the region who are now becoming recognized in their own right as scientists as well."

Energy resupply has been a serious issue for Marines on the ground in international engagements. Reducing the need for, and vulnerabilities of, energy convoys has been front and center for naval research efforts in recent years.

Nayfeh's research focuses on a new nanomaterial called zinc oxide. Changing the size and structure of the oxide allows scientists to "tune" its electrical properties, thereby optimizing the performance of the memory in electronics such as cell phones, digital cameras, laptops and even medical devices and military equipment.

It could also improve the efficiency of fabricated solar cells, which play a role in a number of naval applications and settings.

"We are very happy and honored to have ONR Global-sponsored research featured in this publication," said Nayfeh. "We believe that research is key to building strong human capacity and to continue to enhance technologies to better our world."

The abstract for the article notes that low-dimensional semiconductor

nanostructures are of particular interest in high-performance electronic and photonic devices. ZnO "nanoislands," it says, are promising for future low-power memory applications.

Nayfeh says he realizes the important long-term potential of the research, particularly given the disaster relief role the U.S. Navy plays when crises occur around the world.

"The U.S. Navy is the largest and most capable navy in the world," he noted. "Moreover, the U.S. Navy has a noble duty to support humanitarian assistance and disaster relief.

"Therefore, it is our honor to be a part of this great mission through innovating and providing the latest technology advancements related to future energy devices."

More information: Nazek El-Atab et al. ~3-nm ZnO Nanoislands Deposition and Application in Charge Trapping Memory Grown by Single ALD Step, *Scientific Reports* (2016). DOI: 10.1038/srep38712

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