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Ultra-Sensitive naval electric field sensor using advanced materials

A novel, highly sensitive, silent, and non-corroding quantum material sensor detects minute electric fields in saltwater, enabling cost-effective monitoring of marine life and vessel movements for military and commercial applications.

Although oceans cover most of our planet, provide large amounts of energy and food, and play a key role in the global climate and sustainability, currently available sensing technologies limit the exploitation and understanding of the complex and harsh environments found in oceans. Over the past century, active acoustic sonar, which mimics a dolphin, locates vessels on the surface and underwater by sensing the acoustic wave generated or reflected from them. Unfortunately, sonar systems disturb marine organisms when generating acoustic waves. In addition, such sonar systems consume large amounts of energy and it is difficult to make them small and lightweight. There exists an unmet need for devices and systems to detect electric fields emitted by marine animals and manmade vessels in aqueous environments that are multi-functional, lightweight, highly sensitive, and less expensive than currently available systems.

Purdue University researchers have discovered a new sensing material to detect electric fields emitted by marine animals and manmade vessels, e.g. ships, naval vessels, in aqueous environments, including oceanic conditions. The new sensor uses a samarium nickelate, a class of quantum materials called strongly correlated electron systems, which have exotic electronic and magnetic properties. This quantum material mimics a shark's ability to detect the minute electric fields of small prey and performs well in ocean-like conditions. The material maintains its functional stability and does not corrode after being immersed in saltwater, a prerequisite for ocean sensing; it also functions well in the cold, ambient temperatures typical of seawater. This technology has the potential for broad interest in many disciplines. Potential uses include studying ocean organisms and ecosystems and to monitor the movement of ships for military and commercial maritime applications.

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Category

Aerospace & Defense/Defense Electronics & Surveillance Technologies
Robotics & Automation/Perception & Sensing
Materials Science & Nanotechnology/Advanced Functional Materials

Authors

Shriram Ramanathan
Derek Schwanz
Zhen Zhang

Further information

Will Buchanan
wdbuchanan@prf.org

View online

To view a video related to this technology, click on this link: https://youtu.be/f3UsD-1qGkE

Advantages:

-Uses a quantum material

-Maintains functional stability and does not corrode in saltwater

-Highly sensitive

-Lightweight and silent operations (does not disturb aquatic life)

-Low energy consumption

-Capable of communicating information to satellites via on-chip electronics

-Less expensive than currently available systems

Potential Applications:

-Study ocean organisms and ecosystems

-Monitor the movement of ships for military and commercial maritime applications

-Autonomous vehicles in marine environments

-Locate objects in the ocean such as marine organisms, ships, and unmanned underwater vehicles

-Oceanographers

-Marine biology

Related Publications:

Zhang, Zhen, et al. Perovskite nickelates as electric-field sensors in salt water. Nature, 553, 4 January 2018, pp. 68-72. DOI: 10.1038/nature25008

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Intellectual Property:

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sensing, strongly correlated electron systems, maritime monitoring, aqueous environment sensor, silent operation sensor