Researchers demonstrate organic crystals can serve as energy converters for emerging technologies

May 20 2022

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New research by a team of researchers at the NYU Abu Dhabi (NYUAD) Smart Materials Lab published today in the journal *Nature*

Communications demonstrates that organic crystals, a new class of smart engineering materials, can serve as efficient and sustainable energy conversion materials for advanced technologies such as robotics and electronics.

While organic crystals were previously thought to be fragile, the NYUAD researchers have discovered that some organic crystals are mechanically very robust. They developed a material that establishes a new world record for its ability to switch between different shapes by expansion or contraction over half of its length, without losing its perfectly-ordered structure.

In the study titled *Exceptionally High Work Density of a Ferroelectric Dynamic Organic Crystal around Room Temperature*, the team, led by NYUAD Professor of Chemistry Panče Naumov, presents the process of observing how the organic crystalline material reacted to different temperatures. The researchers found that the organic crystals were able to reversibly change shape in a similar manner to plastics and rubber. Specifically, this material could expand and contract over half of its length (51 percent) repeatedly, over thousands of cycles, without any deterioration. It was also able to both expand and contract at room temperature, as opposed to other materials that require a higher temperature to transform, creating higher energy costs for operation.

Unlike traditional materials that are silicon- or silica-based, and inevitably stiff, heavy and brittle, the materials that will be used for future electronics will be soft and organic in nature. These advanced technologies require materials that are lightweight, resilient to damage, efficient in performance, and also have added qualities such as mechanical flexibility and ability to operate sustainably, with minimal consumption of energy. The results of this study have demonstrated, for the first time, that certain organic crystalline materials meet the needs of these technologies, and can be used in applications such as soft robotics,

artificial muscles, organic optics, and organic electronics (electronics created solely from organic materials).

"This latest discovery from the Smart Materials Lab at NYUAD builds on a series of our previous discoveries about the untapped potential of this new class of materials, which includes adaptive crystals, self-healing crystals, and organic crystalline materials with shape memory," said Naumov. "Our work has shown that organic crystals can not only meet the needs of the emerging technologies, but in some cases can also surpass the levels of efficiency and sustainability of other, more common materials."

More information: Exceptionally High Work Density of a Ferroelectric Dynamic Organic Crystal around Room Temperature, *Nature Communications* (2022).

Provided by New York University

Citation: Researchers demonstrate organic crystals can serve as energy converters for emerging technologies (2022, May 20) retrieved 2 May 2024 from https://phys.org/news/2022-05-crystals-energy-emerging-technologies.html