Researchers design limestone putty nanogenerator to harvest energy from everyday motion to power small devices

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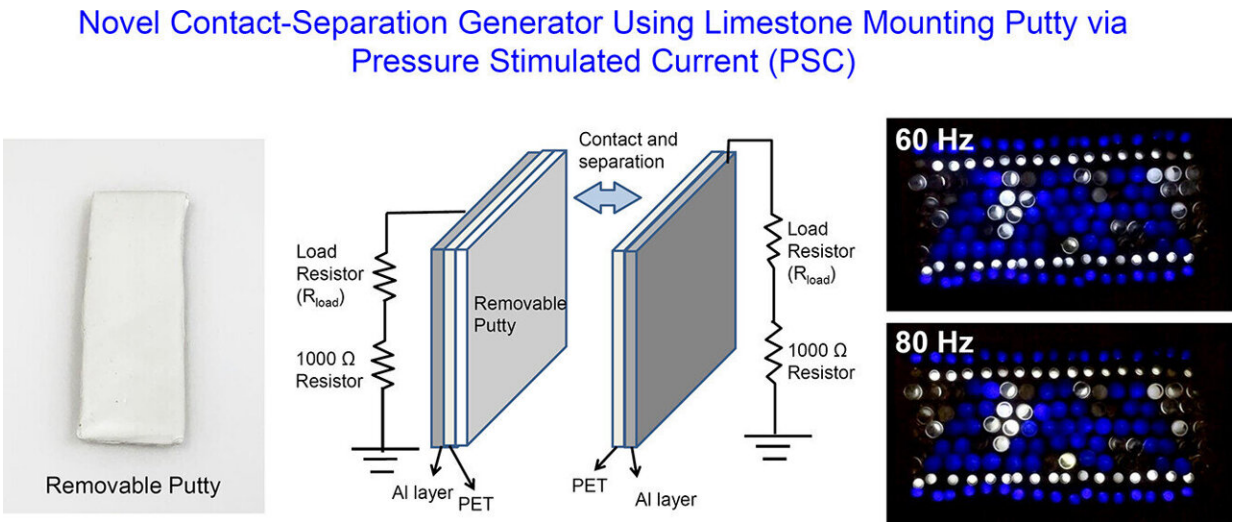

Graphical abstract. Credit: *ACS Omega* (2023). DOI: 10.1021/acsomega.2c07688

Researchers at The University of Alabama in Huntsville (UAH) have created a new kind of triboelectric nanogenerator (TENG) that produces electricity through the use of limestone putty, promising considerable cost savings over conventional manufacturing methods.

Invented in 2012, TENGs are small devices that convert mechanical or thermal energy into electricity for use in small, wireless autonomous devices like those in wearable electronics, condition monitoring and

wireless sensor networks. Examples include heart monitor implants, biochip transponders for farm animals or sensors that alert a driver when tire pressure is low.

TENGs harvest power for these devices by transferring an electric charge between two objects when they contact or slide against one another, through motions such as walking, vibration, rotating tires, moving wind or flowing water, all with very little impact to the environment.

Compared to existing TENGs, which use expensive nanotechnology-based fabrication methods, the UAH breakthrough is a new type of TENG that employs "tacky" materials like double-sided adhesive tape or limestone putty to generate a charge, making it far more cost-effective and simpler to build.

"Traditional TENGs require nanotechnology-based fabrication and other special equipment," points out Dr. Gang Wang, an associate professor of mechanical and aerospace engineering at UAH, a part of the University of Alabama System. "Only craft-level skill is needed to build our triboelectric energy harvester."

The breakthrough is detailed in a paper published in the journal *ACS Omega*. Wang's co-authors at UAH include Dr. Moonhyung Jang, a postdoctoral research assistant, Sean P. Rabbitte, an undergraduate research assistant, and Dr. Yu Lei, chair and an associate professor of chemical and materials engineering.

The research is part of the Department of Defense (DOD) Small Business Innovation Research (SBIR) program, an initiative that supports government-funded contracts or grants that encourage domestic small businesses to engage in federal research and development projects with the potential for commercialization.

"Our industrial partner is Materials Sciences, LLC, and Dr. Simon Chung is the project lead," Wang says. "We have already filed a patent for the triboelectric energy-harvesting design using adhesive layers."

UAH's novel application of a limestone-based mounting putty, along with a metallized polyester sheet, also extends the operational frequency bandwidth compared to existing TENGs. This is significant, because some small energy-harvesting applications, such as health monitoring and wearable exoskeleton systems, require a wider frequency bandwidth to collect the energy from human motion.

"Typical contact-separation TENGs operate at a frequency below 10 Hz," Wang notes. "However, we are able to extend the bandwidth up to 80Hz by introducing these triboelectric layers in a vibration-based energy-harvester design. After the successful demonstration of the TENG design using double-sided tape, we started to explore less tacky materials for easier separation of the materials. This is how we came up with the idea of using limestone-based putty."

The UAH researchers envision future investigation of putty-based generators to explore the effectiveness of different minerals such as marble, sandstone and lunar soil.

More information: Moon-Hyung Jang et al, Power Generation by a Limestone-Contained Putty, *ACS Omega* (2023). DOI: 10.1021/acsomega.2c07688

Provided by University of Alabama in Huntsville

https://phys.org/news/2023-12-limestone-putty-nanogenerator-harvest-energy.html