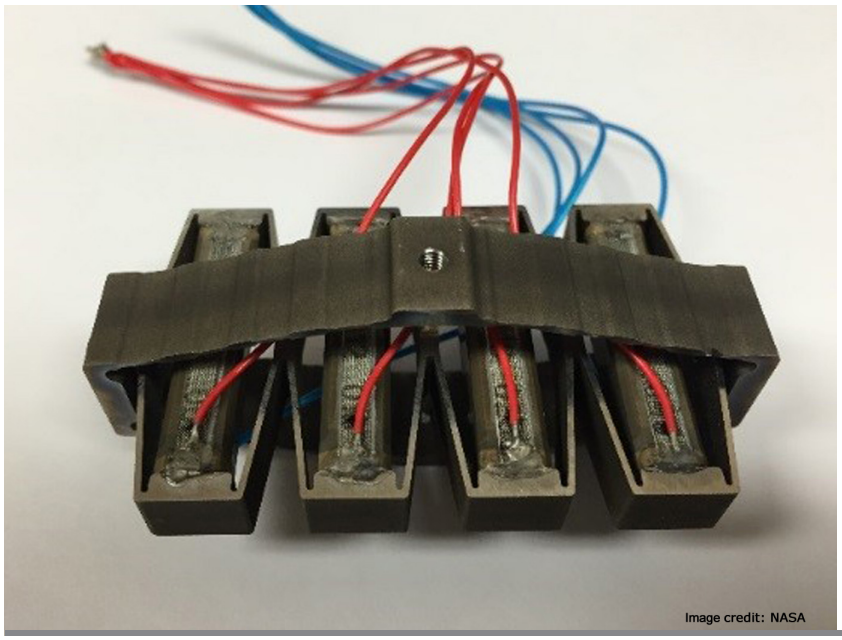


Image credit: NASA

National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Power Generation and Storage

Relaxor Piezoelectric Single Crystal Multilayer Stacks for Energy Harvesting Transducers (RPSEHT)

System to increase the effective piezoelectric constant and mechanical energy input to energy harvesting transducers

NASA Langley Research Center has developed a system to increase the effective piezoelectric constant and the mechanical energy input to energy harvesting transducers. This results in practical performance advantages including higher mechanical-electrical coupling and conversion efficiencies, and more efficient operation across a range of vibrational frequencies.

BENEFITS

- High mechanical-electrical coupling and conversion efficiencies (more than 50% conversion efficiency)
- Efficient operation across a range of vibrational frequencies and temperatures (from cryogenic up to 100 degrees Celsius)

APPLICATIONS

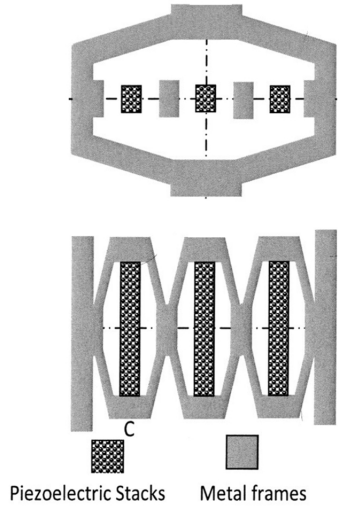
The technology has several potential applications:

- Powering portable electronic devices
- Harvesting waste mechanical energy for aircraft, automobile and other transportation equipment to increase energy efficiency of a dynamic system
- Harvesting electrical power from various vibration sources across a broad range of frequencies
- Powering wireless sensors for structure health monitoring

THE TECHNOLOGY

Energy management is one of the most challenging issues in the world today. Accordingly, various energy harvesting technologies have gained attention, including harvesting energy from ambient vibration sources using piezoelectric materials. However, conventional piezoelectric energy harvesting transducer (PEHT) structures have effective piezoelectric constants that are lower than about 10^4 pC/N, (resonant mode). These low piezoelectric constants lead to conventional PEHTs not being able to harvest electric power effectively. Further, for a specific vibration/motion source, it would be advantageous to maximize the mechanical energy captured from the vibration structure into the piezoelectric device and to convert a greater fraction of that mechanical energy into electrical energy more efficiently.

This invention is a system and method using multistage force amplification of piezoelectric energy harvesting transducers (MFAPEHTs) to increase the effective piezoelectric constant to >10^6 pC/N and to increase the mechanical energy input to the device. The invention utilizes 33 mode PZT to permit maximum coupling between the input mechanical energy with the piezoelectric material, and multilayer construction of single crystal PMN-PT material to significantly amplify the voltage/charge generation and storage from the applied mechanical force.



Drawing of device
Image credit: NASA

PUBLICATIONS

Patent No: 9,048,759

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

LAR-17967-1, LAR-TOPS-186

More Information

National Aeronautics and Space Administration

Agency Licensing Concierge

Langley Research Center

Mail Stop 020
Hampton, VA 23681
202-358-7432
Agency-Patent-Licensing@mail.nasa.gov

www.nasa.gov

NP-2015-08-2027-HQ