Compliant electrode and composite materials for piezoelectric wind and mechanical energy conversions

NASAs Piezoelectric Energy Harvesting Technology

Thin film, piezoelectric materials generate a small voltage whenever they are deformed, suggesting that they are suitable for tapping energy from freely available resources, such as the wind. Yet their low-energy production levels and lack of electrode durability have hampered development. NASA researchers have invented a system, method, and device for improving the performance and increasing the lifespan of small form factor, thin film electrode, piezoelectric devices capable of interacting with the wind to provide power to wearable devices and stretchable electronics.

**BENEFITS**
- The metal oxide improves the conductance
- Carbon based electrodes improve durability
- Polymer-to-polymer design eliminates the need for an adhesion layer
- Can be stretched while still maintaining functionality
- Small, lightweight
- High conversion efficiency
THE TECHNOLOGY

The NASA researchers integrated two innovations into this unique piezoelectric device. First, they combined polyvinylidene fluoride (PVDF) with a metal oxide to improve conductance. Second, they designed a new carbon-electrode to improve durability (compliance) and reduce susceptibility to fatigue while retaining flexibility. Additionally, to integrate the carbon nanotube components, they use a polymer-to-polymer design that eliminates the need for adhesion layers. A prototype device generated 1 W power (at 15 mph wind) with a single layer of PVDF [4 inch by 12 inch and 50 um (micrometer) thick] sandwiched between two thin electrode films. A rectifier converts the AC signal into a DC signal and stores the charge in a capacitor. This electric power can be used for low power consuming devices, such as inaccessible sensors.

APPLICATIONS

The technology has several potential applications:
- Wearable electronics
- Wind energy harvesting
- Mechanical energy harvesting
- Sustainable energy

PUBLICATIONS

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