Functional materials

Ceramic electret for electrostatic vibration power generation

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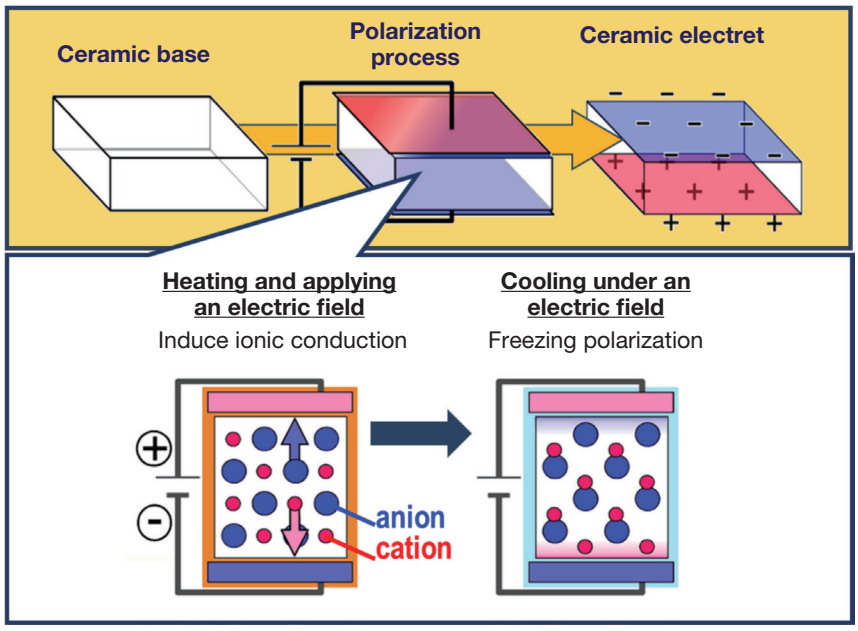
Purpose of Research

Some small-size vibration power generators use what is known as "environmental vibrations," which are generated by the movement of people, vehicles, and machines, as a power source. Recently, there has been a move to put this type of generator to practical use. Electrostatic vibration power generation is a vibration-to-power conversion method that uses an electret, which is a material that stably holds static electricity. This research aims to develop a ceramic electret for electrostatic vibration power generation.

Summary of Research

While many types of electrets use polymers as the base material, this research uses a ceramic base material that exhibits properties that are in between those of dielectrics and ionic conductors depending on temperature. To turn a ceramic base into an electret, apply a DC electric field and heat to the material to induce ionic polarization in it, and then cool it under the electric field to room temperature to freeze the polarization. Using this method, we have developed an electret that holds a surface potential exceeding ± 4000 V.



Points

- Generates a surface electric potential of ± 4000 V or higher on a planar element
- Has a heat resistant property superior to polymers (maintains the surface electric potential up to about 80°C)
- The surface electric potential can be increased by laminating multiple films

Comparison with Conventional or Competitive Technologies

- Surface charge density is dramatically increased (double-digit increase or more).
- Surface charge stability is dramatically improved (semi-permanent).

Expected Applications

- Vibration power generators for devices with a power consumption of microwatts to milliwatts (Such as sensor nodes for wireless sensor networks)
- Special substrates that exhibit a peculiar selective adsorption property for ions and molecules using a local electric field

Challenges in Implementation

We have developed a high-performance bulk ceramic electret with a thickness of about 1 mm. Making a thin-film electret is the main challenge before this technology can be put to practical use. It is necessary to establish a technology that applies a high surface electric potential to a film with a thickness of tens of microns.

What We Expect from Companies

We hope to conduct a joint research program with a company that holds a ceramic thin film manufacturing technology or a company that is developing vibration power generators and plans to advance into the IoT market.

- Associated System: JST's CREST program, Grants-in-Aid for Scientific Research
- Intellectual Property: Japanese Patent Application No. 2014-141797 "Electret Materials and Manufacturing Method," and others
- Prototype: Completed

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