Harvesting Energy from Everyday Movements by Developing a Two-Dimensional MXene-Based Triboelectric Nanogenerator

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Portable electronics, such as mobile phones and biomedical devices, have been integrated into the lifestyle of many people and are growing rapidly. These technologies rely heavily on batteries to operate; however, despite great success in making longer-life batteries, they still need to be charged quite often. This project aims at developing a low-cost and highly efficient device that can harvest energy from everyday human movements. To achieve this, a new family of two-dimensional MXenes with high electronegativity, excellent conductivity, and mechanical stability is used to fabricate a new generation of triboelectric nanogenerators (MXene-TENGs). With the principles of electrostatic induction and triboelectricity combined with the properties of MXenes, a single 2.5 x 5 cm^2 MXene-TENG is able to generate an output voltage of about 3-5 Volts. This is matched with the required voltage of portable electronics. To further expand the project, experiments analyzing the effects of MXene coating thickness and bending angle on the TENG resistance are conducted. It is found that increasing the number of coatings significantly increases the electrical conductivity of the electrode and output voltage. The bending angle, however, does not show a significant impact on the performance of the device. Furthermore, the real-world application of the device is demonstrated by turning on and off an LED. These findings open up an opportunity to design flexible, complex, and efficient structures that can be integrated into shoes and clothing.

Awards Won:

Third Award of $1,000