Regeneron WESEF 2023 Finalist

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Environmental Science

Piezoelectric Energy Harvesting in Daily Life: Powering the Next Generation of Modern Technology

Efforts to fight the effects of climate change have pushed talk of clean energy sources to the forefront of concern. The most well-known forms of sustainable energy rely on large structures and vast amounts of space. Additionally, there is still an absence of clean energy sources for devices that do not directly interact with the outdoor environment (such as solar, hydro, or wind-powered mechanisms). Mechanical energy is readily available everywhere in nature and can be harvested from simplistic, routine actions such as walking, talking, and even typing on a keyboard. Recently, a targeted focus on energy harvesting concerning mechanical vibrational energy began, bringing serious consideration to mechanical energy as a constant, reliable energy source. However, many mechanical vibrations from everyday actions are still lacking attention, therefore that energy is often wasted. Piezoelectricity is a process that can harvest these neglected vibrations and convert them into usable electricity. Utilizing electromechanical conversion characteristics of piezoelectric material to gather the vibration energy could supply the energy it takes to charge a device on the go. When typing on a computer, humans produce vibrations on the keys of the keyboard. This phenomenon is what leads me to believe piezoelectric elements are suitable for computers as a medium for the forward piezoelectric effect (converting mechanical energy into electrical energy). Thus, the materials could be suitable for creating a self-charging electronic device by harvesting mechanical typing energy, converting it into electrical energy, and wiring the piezoelectric elements back into the battery of the computer. In this study, I designed and built a self-charging laptop utilizing piezoelectric elements. During testing, I was able to produce electrical currents harvested from mechanical energy while typing. A range of 0.436V to 1.643V was generated per keystroke, showing proof of concept for the viability of this design with improved materials and continued research. Not only does removing restrictions such as a charging cable allow for greater convenience while using electronic devices, but also introduces usage for a new source of sustainable energy.