Energy-Generating and Power-Storing Seashell

Xie, Anfeng (School: St. Paul's School)

Access to energy remains a demanding issue for island and coastal inhabitants due to their remoteness, with an estimated 70% of Pacific islander households and 57% of sub-Saharan African residents struggling to turn their lights on at night. In areas without access to the electrical grid, villagers often use kerosene lamps to provide illumination. However, burning kerosene produces inadequate lighting and emits harmful pollutants like soot and CO2, which cause respiratory problems and environmental damage. Since current wave-power designs are expensive to create and maintain, this prototype is cheap and above water, utilizing a lever-gear mechanism to capture and amplify the mechanical energy of waves. With the seashell applying a vertical force on the lever, the lever pushes up a gear system that spins the magnets past coils with maximized speed, inducing electricity through electromagnetic induction. The energy induced then passes a three-phase-full-bridge rectifier that transforms the AC into DC, usable for appliances. After experiments, the device could output a DC voltage of 3.35V, charge a supercapacitor battery from 0V to 2.99V in 2.239min, and be capable of functioning for around 12 hours daily with minor shifts in water level. If the device harvests wave energy for 12 hours with a wave frequency of 0.5Hz, the energy can power a 3W LED light bulb for approximately 6hr and 48.6min. This research alleviates coastal families' health issues and demonstrates the potential for wave-powered technology as an innovative and cost-effective accommodation for individuals living in coastal areas.

Awards Won: