Chlorine-Emulsified PDMS for Water Droplet Based Energy Harvesting

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The use of smart devices in applications like wildlife tracking and blue energy has become widespread, relying on batteries to power devices in remote locations. However, the frequent maintenance involved with battery-powered devices makes self-powered devices a more attractive and sustainable alternative. Previous studies indicate that triboelectric nanogenerators (TENGs) are scalable, cost-effective, and suitable options for energy harvesting from ultra-low-frequency vibrations, such as waves or human motion. In this experiment, varying amounts and concentrations of benzyl chloride solution were emulsified in polydimethylsiloxane (PDMS) to serve as a triboelectric material in a solid-liquid water-droplet-based TENG. Increasing the amount and concentration of the benzyl chloride solution was hypothesized to increase the electrical output of the TENG because of chlorine's high electron affinity, which should result in a greater difference in charge affinity between the PDMS and the water droplets that slide across it. To measure electrical output, the two electrodes in contact with the PDMS were attached to an electrometer, which produced a reading when water droplets slid across the electrodes. The TENG showed a statistically significant increase in voltage when the benzyl chloride concentration was increased from 0% to 6%, though there was no significant difference between 6% and 10%. This may be because the lower permeability of higher concentration solutions countered the effects of the chlorine group. Nonetheless, the results indicate that functional emulsion can improve the performance of a flexible PDMS TENG in harvesting energy from water droplets and, hypothetically, rain and flowing water sources in the real world.

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