Development of a Triboelectric Nanogenerator to Test the Effect of Frequency on Energy Output

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In modern society, the power field is dominated by non-renewable methods of energy generation that harm the environment. Because of this, finding sustainable methods of power production is crucial in our increasingly energy-reliant world. Hence, we sought to find an efficient way to produce electricity using a contact-separation triboelectric nanogenerator (TENG). The main objective was two-fold: design and build a TENG and determine the impact of frequency on energy generated. Using Polyvinyl chloride and cotton – materials present on the triboelectric series – we constructed a TENG. After multiple iterations, our final design allowed for multiple instances of contact-separation from a single impact due to the cotton being loosely attached. This increased the total charge accumulated. Tests were conducted using a series of controlled compressive forces via human footsteps to simulate possible real-world applications alongside a metronome for constant frequencies between 30 and 180 impacts per minute. The generated charge was collected in a 4.7 micro-Farad capacitor and measured via an oscilloscope. The average amount of peak voltage measured varied between 108mV and 980mV throughout the different frequencies, with higher frequencies having higher voltages. Using the relationship between stored energy and voltage, we determined that the energy generated was between 0.02741 micro-joules and 2.257 micro-joules. This indicates the immense importance of frequency of impacts to energy generated. These findings imply that TENGs, specifically ones based on contact separation, can be an effective source of energy if placed in areas of high foot traffic.

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