Wood-n't It Be Nice: Demonstrating a Novel Continuous Piezoelectric Charge Pump

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This project engineered a continuous charge pump for a biodegradable piezoelectric transducer made from wood shavings infused with Rochelle salt. Initially, electrode layout and material were optimized using a point contact to generate voltage. Copper electrical tape was compared to carbon conductive paint, showing no statistical difference between the two electrode types (p=0.85). Two electrode geometries were tested: electrodes placed perpendicular or placed parallel to the wood grain. With-grain electrodes produced an average of 2960mV, while cross-grain electrodes produced 1866mV. The sample sets were statistically different from each other (p=0.02). Therefore, copper electrodes were placed along the grain on future trials. Next, wood shaving thickness was optimized against electrode distance apart. The average wood thicknesses were 0.24mm, 0.30mm, and 0.35mm, and electrodes were placed 0mm, 3mm, 6mm, and 9mm apart. The highest average voltage, 3561mV, occurred in 0.24mm wood with electrodes 3mm apart. Because ANOVAs showed statistical differences between thicknesses and distances (p=1.39*10^-7 and p=0.046, respectively), this was chosen to be optimal. To demonstrate a continuous charge pump, the optimized configuration was pushed through the nip roll of a pasta maker. Balancing nip pressure and minimizing wood breakage delivered a sustained charge averaging 676mV. In the future, the roller nip setup can be further optimized to avoid excessive breakage. Potential uses for the charge pump include within a belt and rollers that form a nip, or a transducer wheel that creates energy while rolling. Finally, the pump should be modified to harvest energy rather than simply creating charge.

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