Utilizing a Piezoelectric Crystal Tree to Harvest Electrical Energy from Rain Water

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This multiphase study was conducted to evaluate the feasibility of utilizing a piezoelectric crystal tree to harvest electrical energy from rain water to use as a clean, renewable energy source. The piezoelectric effect is the ability of certain materials to generate an electrical change when subjected to a mechanical stress, such as a vibration. A bio-inspired, PVC pipe testing stand was developed to mimic a tree. A PVDF piezoelectric crystal beam branch converted the kinetic energy of the raindrops to electrical energy. In Phase I, a leaf appendage was designed, 3D-printed, and attached to the beam to increase the efficiency of the beam and reduce the propensity of the water drops to pool and/or splatter. It was determined that of the four different scaled sizes of the leaf tested, the “small leaf” aided the piezoelectric beam in producing the most electrical energy. In Phase II, the optimal location for the water drops to strike the beam was investigated: the leaf appendage, the end of the beam with an appendage, and the control beam. The 45 trials varied three diameters of dispensing needles and five water fall heights. It was determined that targeting the leaf appendage aided the piezoelectric beam in producing the most electrical energy and could increase the beam’s efficiency by 10%. In both phases, the hypotheses were accepted. In Phase III, a reconfigurable PVC tree with ten piezoelectric beam branches arranged in a cascading design was constructed to compare the electrical output of beams with and without leaf appendages. The water used by the tree is neither consumed nor contaminated and the tree can be incorporated into existing water runoff and wastewater treatment systems. The goal is to develop a sustainable, environmentally-friendly energy source.

Awards Won:

Third Award of $1,000