The Effects of Lattice Structure on SLA 3D Printed Piezoelectric PVDF

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Piezoelectric materials are tremendously useful but tragically limited. The poor structural properties, expense, and inaccessibility of custom piezoelectric materials have limited their utility since their discovery. This study developed an accessible procedure by which piezoelectrics can be SLA 3D printed in unlimited configurations with tailorable structural and electrical properties and, in doing so, helped to overcome the aforementioned limitations. In order to demonstrate and expand the utility of custom piezoelectrics, different types of lattice structure were manufactured and analyzed to determine and compare their properties. Because the focus of this research was practical, the analyzed properties of these lattice structures were chosen based on the insight they could contribute to real-world lattice-type selections. To carry out this experiment, some of the most common and effective lattice structures were designed to have equal volume and unit-cell scale and printed in a PVDF-infused photopolymer resin with an SLA 3D printer. The solvent used to disperse the PVDF in the resin was removed from the printed test samples with a heated vacuum chamber after which the samples were polarized with a high-voltage power supply and analyzed with a tensile test machine and a high-gain amplifier. All of these devices were fabricated by the experimenter to reduce price and increase accessibility. The results of these tests established that there is a very high degree of variation in the structural and electrical properties of different lattice structure types and determined the properties used to make that determination. More importantly, this experiment established the efficacy of an accessible process that can be used to make custom piezoelectrics.

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