Mechanical Engineering Thesis Defense

Triply Periodic Minimal Surface Structure Density Effect on the Power Conversion Performance of a Thermogalvanic Brick

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Abstract

Humans are currently facing issues with the high level of carbon emissions that will cause global warming and climate change which worsens the earth's environment. Buildings generate nearly 40% of annual global CO2 emissions, of which 28% is from building operations, and 11% from materials and construction. These emissions must decrease to protect from further environmental harm. The good news is there is a way that carbon emissions can be decreased. The use of thermogalvanic bricks enables electricity generation by the temperature difference between the enclosure above the ceiling (i.e., the attic in a single-family home) and the living space below. A ceiling tile prototype was constructed that can make use of this temperature difference to generate electricity using an electrochemical system called a thermogalvanic cell. Furthermore, the application of triply periodic minimal surfaces (TPMS) can reduce the thermal conductivity of the ceiling tile, which is important for practical applications. Here, Schwarz P TPMS structures were 3D-printed from polyvinylidene fluoride (PVDF) and inserted into the electrolyte solution between the electrodes. Graphite was used as electrodes on the positive and negative sides of the tile, and Iron (II) and Iron (III) perchlorate salts were used as electrolytes. The maximum generated power was measured with different densities of TPMS structure, and one experiment without a TPMS structure. The results indicated that as the density of the TPMS structure increase, the maximum decreases. The experiment with zero density had the largest maximum power.

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Zoom Link:

https://asu.zoom.us/j/62285781653?pwd=V01XRC9DdHVnbjh5TEJsQU0zdTBEdz09