Mechanical Engineering Thesis Defense

Experimental Measurements of the Power Output of a Copper/Copper(II) Thermogalvanic Brick

School for Engineering of Matter, Transport and Energy

William Lee

Advisor: Patrick Phelan

abstract

Buildings continue to take up a significant portion of the global energy consumption, meaning there are significant research opportunities in reducing the energy consumption of the building sector. One widely studied area is waste heat recovery. The purpose of this research is to test a prototype thermogalvanic cell in the form factor of a UK metric brick sized at 215 mm × 102.5 mm × 65 mm for the experimental power output using a copper/copper(II) (Cu/Cu2+) based aqueous electrode. In this study the thermogalvanic brick uses a 0.7 M CuSO4 + 0.1 M H2SO4 aqueous electrolyte with copper electrodes as two of the walls. The other walls of the thermogalvanic brick are made of 0.22 in thick acrylic sheet. Internal to the brick, a 0.2 volume fraction minimal surface Schwartz diamond (Schwartz D) structure made of ABS, Polycarbonate-ABS (PCABS), and Polycarbonate-Carbon Fiber (PCCF) will be tested to see the effects on the power output of the thermogalvanic brick. By changing the size of the thermogalvanic cell into that of a brick will allow this thermogalvanic cell to become the literal building blocks of green buildings. The thermogalvanic brick was tested by applying a constant power to the strip heater attached to the hot side of the brick, resulting in various ΔT values between 8°C and 15°C depending on the material of Schwartz D inside. From this, it was found that a single Cu/Cu2+ thermogalvanic brick containing the PCCF Schwartz D performed the best at 31.4% better than the control brick containing only electrolyte solution.

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