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Power-Generating Thermogalvanic Bricks

Background

Buildings account for approximately 40% of all energy consumed, with ever-increasing demand from new embedded electronic devices. Meeting these energy requirements involves consideration of both practical and environmental concerns. Modern solar arrays, for example, can offer an independent, off-grid power source that can be well suited for integration into building structures like rooftops.

Just as incident sunlight can provide usable energy for buildings, existing temperature gradients also present energy-harvesting opportunities. In particular, effective capitalization of the temperature difference between a building's interior and exterior can provide a new energy source for both developed and developing markets. A practical adaptation into walls must then also confer scalability, structural strength, and sufficient thermal insulation.

Invention Description

Researchers at Arizona State University have designed a thermogalvanic power-generating brick that converts temperature differences across its width into useful power. Emphasis is placed on the engineering of thermal resistance to avoid counterproductive loading of any heating, ventilation, and air conditioning (HVAC) systems used to maintain interior temperatures. In developing economies that may lack HVAC systems, naturally occurring temperature differences can still be exploited for energy generation.

Structural integrity is provided largely by the brick's internal periodic frame model, while a substance used as filling supports thermogalvanic electrochemical processes and provides thermal resistance. Much of the design can be 3D-printed using recycled plastics.

In addition to exterior wall construction, the bricks can be used for partitioning areas within buildings, such as occupied and non-occupied spaces (e.g., attics, basements). This invention transforms conventionally passive structural elements into active sources of power, day and night.

Potential Applications

- "Smart" structures
- Humanitarian efforts
- Off-grid or remote buildings
- Warehouses

Benefits and Advantages

- Innovative – Combines the features of passive structural elements with power generation capabilities
- Cost Effective – Thermogalvanic cells are less expensive than comparable solid-state thermoelectric devices
- Versatile – Can generate power in the daytime and nighttime

Homepage of Professor Patrick Phelan