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Heat Sink Optimization for a High Power Wearable Thermoelectric Module

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Abstract : As a result of current energy and environmental issues, the human body is known as one of the promising candidate for converting wasted heat to electricity (Seebeck effect). Thermoelectric generator (TEG) is one of the most prevalent means of harvesting body heat and converting that to eco-friendly electrical power. However, the uneven distribution of the body heat and its curvature geometry restrict harvesting adequate amount of energy. To perfectly transform the heat radiated by the body into power, the most direct solution is conforming the thermoelectric generators (TEG) with the arbitrary surface of the body and increase the temperature difference across the thermoelectric legs. Due to this, a computational survey through COMSOL Multiphysics is presented in this paper with the main focus on the impact of integrating a flexible wearable TEG with a corrugated shaped heat sink on the module power output. To eliminate external parameters (temperature, air flow, humidity), the simulations are conducted within indoor thermal level and when the wearer is stationary. The full thermoelectric characterization of the proposed TEG fabricated by a wavy shape heat sink has been computed leading to a maximum power output of 25µW/cm2 at a temperature gradient nearly 13°C. It is noteworthy that for the flexibility of the proposed TEG and heat sink, the applicability and efficiency of the module stay high even on the curved surfaces of the body. As a consequence, the results demonstrate the superiority of such a TEG to the most state of the art counterparts fabricated with no heat sink and offer a new train of thought for the development of self-sustained and unobtrusive wearable power suppliers which generate energy from low grade dissipated heat from the body.

Keywords : device simulation, flexible thermoelectric module, heat sink, human body heat
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