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Optimization of a Flexible Thermoelectric Generator for Energy Harvesting from Human Skin to Power Wearable Electronics

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Abstract : A flexible thermoelectric generator is one method for recycling waste heat. This research provides the optimum performance of a flexible thermoelectric generator with optimal geometric parameters and a detailed structural design. In this research, a numerical simulation and experiment were carried out to develop an efficient, flexible thermoelectric generator for energy harvesting from human skin. Heteromorphic electrodes and a polyimide substrate with a copper-printed circuit board were introduced into the structural design of a flexible thermoelectric generator. The heteromorphic electrode was used as a heat sink and component of a flexible thermoelectric generator to enhance the temperature difference within the thermoelectric legs. Both N-type and P-type thermoelectric legs were made of bismuth selenium telluride (Bi1.7Te3.7Se0.3) and bismuth antimony telluride (Bi0.4Sb1.6Te3). The output power of the flexible thermoelectric generator was analyzed under different heat source temperatures and heat dissipation conditions. The COMSOL Multiphysics 5.6 software was used to conduct the simulation, which was validated by experiment. It is recorded that the maximum power output of 232.064μW was obtained by considering different wind speed conditions, the ambient temperature of 20℃, and the heat source temperature of 36℃ under various load resistance conditions, which range from 0.24Ω to 0. 91Ω. According to this finding, heteromorphic electrodes have a significant impact on the performance of the device.

Keywords : flexible thermoelectric generator, optimization, performance, temperature gradient, waste heat recovery
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