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Impact of Legs Geometry on the Efficiency of Thermoelectric Devices

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Abstract : Key concepts like waste heat recycling or waste heat recovery are the basic ideas in thermoelectricity so as to the design the newest solid state sources of energy for a stable supply of electricity and environmental protection. According to several theoretical predictions; at device level, the geometry and configuration of the thermoelectric legs are crucial in the thermoelectric performance of the thermoelectric modules. Thus, in this work, it has studied the geometry effect of legs on the thermoelectric figure of merit ZT of the device. First, asymmetrical legs are proposed in order to reduce the overall thermal conductance of the device so as to increase the temperature gradient in the legs, as well as by harnessing the Thomson effect, which is generally neglected in conventional symmetrical thermoelectric legs. It has been developed a novel design of a thermoelectric module having asymmetrical legs, and by first time it has been validated experimentally its thermoelectric performance by realizing a proof-of-concept device which shows to have almost twofold the thermoelectric figure of merit as compared to conventional one. Moreover, it has been also varied the length of thermoelectric legs in order to analyze its effect on the thermoelectric performance of the device. Along with this, it has studied the impact of contact resistance in these systems. Experimental results show that device architecture can improve up to twofold the thermoelectric performance of the device.

Keywords : asymmetrical legs, heat recovery, heat recycling, thermoelectric module, Thompson effect
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