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Fabrication of Wearable Thermoelectric Power Generator

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Abstract

Thermoelectric generator (TEG) is proposed as a solid state energy harvester from waste heat sources. TEG produces the electrical power from a temperature differences applied across the device. Over the last decade, the human body has been considered as a heat source for the wearable TEGs. It may become attraction for an alternative power generation technique compared to other conventional ones used for many wearable devices. The energy conversion of the wearable TEGs has been demonstrated in order of micro watt range or less. It is therefore becomes a challenge to generate sufficient amounts of energy from body heat source to gain more energy intensive devices. The amount of generated electrical power being produced from TEG depends on material properties (*ZT*) and temperature different between two sides of module (ΔT). Bismuth telluride (Bi_2Te_3) and antimony telluride (Sb_2Te_3) alloy are the most commonly used as TE materials because of their high *ZT* value at room temperature. Moreover, these materials are also easily deposited in thin films to make the flexible devices. In this work, the deposition processes of n-type Bi_2Te_3 and p-type Sb_2Te_3 thin films on flexible substrate will be investigated. It has been shown that the highly (00*l*)-oriented Bi_2Te_3 and Sb_2Te_3 structures are expected to create a higher thermoelectric performance (both electrical and thermal properties) than ordinary films. The dc magnetron sputtering conditions such as sputtering power, working pressure and substrate temperature were optimized. The high thermoelectric performance of thin films was achieved. With relationship between thermoelectric properties and microstructure/stoichiometric composition, the designed structure of layered compact feature with stoichiometry provides the relatively high thermoelectric efficiency.

Keywords: Wearable Thermoelectric; Power Generator; Bi_2Te_3 film; Sb_2Te_3 film