

Balanced heat flux (flow) is needed in thermoelectric power generation

- [Yoshiyasu Takefuji](#), Professor, Keio University

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Jian He et al., wrote an article entitled "Advances in thermoelectric materials research: Looking back and moving forward" published in Science (1). The temperature difference between the hot end and the cold end ( $T_{hot} - T_{cold}$ ) plays a key role in thermoelectric power generation. Many of researchers do not know the relationship between the temperature difference and heat flux. Heat flux caused by the temperature difference is needed in thermoelectric power generation. No heat flux means no power generation even if you have the large temperature difference. Fig. 1 shows a no-heat-flux example using 220 degree Celsius heat source and 20 degree Celsius air for cooling (2). Little power is generated because of no heat flux in Fig. 1 (2). In order to generate power, heat dissipation to the air must be enhanced. Heat pipes are used for improving heat dissipation to the air (3). In other words, Seebeck formula is true if heat flux (flow) is satisfied in thermoelectric power generation, false otherwise. The balanced heat flux (flow) caused by the temperature difference can generate the maximum power in thermoelectric power generation.

References:

1. Jian He et al., Advances in thermoelectric materials research: Looking back and moving forward, Science 29 Sep 2017: Vol. 357, Issue 6358, eaak9997

2. Fig.1:

<http://web.sfc.keio.ac.jp/~takefuji/Fig1.pdf>

3. Flat heat pipes can enhance electrocaloric cooling by improving heat dissipation to the air, Science (eLetter, 26 September 2017)

<http://science.sciencemag.org/content/357/6356/1130/tab-e-letters>