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Oxide Thermoelectric Power Generator Operated at 800 K in Air

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High-efficiency of energy conservation of waste heat has attracted much interest in recent years. To use the blackbody radiation emitted from a high temperature object is a smart way to control this kind of heat. With a focusing technique, emitted light becomes a heat source again. Via thermoelectric effect, the heat can be converted into electricity for industrial application.

In the previous JSAP Fall meeting, we introduced a thermoelectric power generator which can convert blackbody radiation into electricity. A halogen lamp was used as a blackbody radiation source and an ellipse lampshade concentrated the emitted light to one point. By a uni-couple of p-n junction, the blackbody radiation is converted into electricity. Oxide single crystals of $Bi_2Sr_2Co_2O_y$ (p-type) and $Ca_{0.98}Yb_{0.02}MnO_3$ (n-type) were used in the experiment because of their high thermal and chemical stabilities, which realize long time use at high temperature in air. Furthermore, we calculated the efficiency proposed by G. J. Snyder and T. S. Ursell [1]. The observed data indicate an ideal efficiency of 2.1%.

Now, we continue to pursue a high-efficiency power generator by changing materials for the p-n junction. Single crystal of $Ca_3Co_4O_9$ for p-type and poly crystal of $Ca_{0.9}Yb_{0.1}MnO_3$ for n-type are used in our new research. These materials exhibit outstanding thermoelectric properties in high temperature as well as high thermal and chemical stability as is reported in the literature [2] [3]. With a 1000 K for a hot side and a temperature difference of 500 K, a properly chosen size of the samples are expected to give the efficiency larger than 10%.

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Reference:

[1] G.J. Snyder and T. S. Ursell, Phys. Rev. Lett., **91**, 148301 (2003).

[2] M. Shikano and R. Funahashi, Appl. Phys. Lett. **82**, 1851 (2003)

[3] D. Flahaut *et al*., J. Appl. Phys. **100**, 084911 (2006).