Brief Summary for the Joint Research

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The joint research with the Karppinen group in Aalto University has been conducted for three years from April 2009 to March 2012. From the Japan side, the research fund is given by Japan Science and Technology Agency (JST), under the program entitled "Strategic Japanese-Finland Cooperative Program on Functional Materials." The practical targets proposed in this project include

- Physics and chemistry for the presently known thermoelectric oxides
- Novel oxide thermoelectric materials
- Novel devices including thin-film growth and nano-structure engineering.

Since this JST fund mainly covers the mutual exchange, we have conducted thermoelectric research and development with other supports. Dr. Kobayashi, one of our members, has carried out his own research funded by PRESTO, JST.

As for the physics and chemistry of the known thermoelectric oxides, we have clarified how and why the spin state of the cobalt ions affects the thermoelectric properties [1]. We have further found that the spin-state disorder causes unconventional emergent behaviors, such as the weak ferromagnetism in $LaCo_{1-x}Rh_xO_3$ [2] and the enhanced thermopower in $La_{0.8}Sr_{0.2}Co_{1-x}Rh_xO_3$ [3]. We have searched for a new n-type thermoelectric oxide, and have found a largely anisotropic thermopower in $SrNbO_{3.4+d}$ single crystals [4], and a large thermopower and a low thermal conductivity in $Sr_{2-x}La_xErRuO_6$. For the novel devices, we have pursued a possibility of heat-flow rectification using transition-metal oxides [5]. We have also proposed a thermoelectric device made of large thermopower materials [6], and have made a trial product of such a thermoelectric power generator [7]. In this talk, I will summarize our three-year collaboration, and briefly comment what to do in the future thermoelectric studies.

References

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