Printed thermoelectric device

K.Miyazaki[1], T. Yabuki[1], L. Tranchant[1], and K. Kato[2]
[1] Kyushu Institute of Technology, 1-1 Sensui-cho, Tobata-ku, Kitakyushu, Japan
[2] Lintec co.ltd., 7-7-3 Tsuji, Minami-ku, Saitama, Japan

We have developed a thermoelectric device by using a printing method. A mixture of Bismuth Telluride micro-particles and PEDOT:PSS as a conductive polymer with several organic additives was prepared. The poly-acrylic acid is added in the mixture for connecting bismuth telluride particles mechanically and electrically. The measured figure of merit of the bismuth telluride thin film fabricated by spin-coating the mixture was 0.2 at 300K due to its low thermal conductivity [1]. The measured thermal conductivity was much lower than the predicted value by a conventional model for the thermal conductivity of a composite. We made multi-layered films with Bismuth Tellride and Poly-imide films with different thicknesses to measure the interfacial resistance between a Bismuth Telluride film and a Poly-imide film. The Bismuth Telluride films were deposited on the alumina substrate by arc-plasma method, and the Poly-imide films were made by spin-coating of poly-amic acid and annealing at 473K. The cross-plane thermal conductivity was measured by a differential 3 omega method. The measured thermal resistance was the order of 10^{-7} ($m^2 \cdot K$)/W. It was about 10 times higher than the interfacial resistance between inorganic-inorganic materials, but it is similar to the interfacial resistance between organic-inorganic materials [2]. The thermal conductivity of the composite film of Bismuth Telluride and poly-imide was well explained by the thermal resistances. Now, we have developed the organic materials for the mixture to print them to make a thermoelectric device as shown in Fig. 1. The thermal design is also important to enhance the output power of thermoelectric device as well as the development of the materials with high-ZT [3]. The power density of the device was 35μW/cm^2 at 323K, and the total output power becomes 1mW.

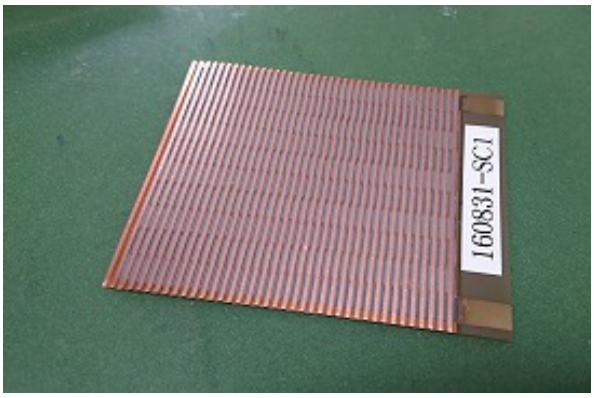

Fig. 1: Printed thermoelectric mini-generator with a mixture of Bismuth telluride and organic additives.

[1] K. Kato, H. Hagino, and K. Miyazaki, *J.Electronic. Mater*. **42**, 1313 (2013).

[2] Interfacial thermal conductance database, http://interface.nims.go.jp/index.html

[3] S. Hama, T. Yabuki, L.Tranchant, and K. Miyazaki, *J. Phys.: Conf. Series*, **660**, 012088 (2015).