Preparation and Characterization of Polyethylenimine Functionalized as Reduced Graphene Oxide for Thermoelectric Applications

*V. Pandiyarasan, Y. Suzuki, F. Salleh, M. Omprakash, M. Navaneethan, Y. Hayakawa, H. Ikeda
Research Institute of Electronics, Shizuoka University, Hamamatsu, Japan.
E-mail: pandiyarasan@rie.shizuoka.ac.jp

[Background]
This report demonstrates application of reduced graphene oxide (RGO) for wearable thermoelectric generators. The RGO is prepared by a simple hydrothermal method, in which polyethylenimine (PEI) is used as a reducing agent of graphene oxide (GO) grown by the modified Hummers method. In literatures, the structural and morphological studies reveal the degree of reduction, which is also verified by the D-band/G-band ratio in Raman spectra ($I_D/I_G$). The $sp^2$/$sp^3$ ratio in X-ray photoelectron spectroscopy (XPS) of RGO indicates a significant increase in the intensity of C=C bond character, while the oxygen content decreases manifestly after the reduction is complete [1-4]. In this report, we focus on n-type thermoelectric characteristics.

[Experimental]
Figure 1 shows a facile approach of in-situ reduction of GO with PEI as a reducing agent and its surface modification to obtain conducting RGO.

[Result and Discussion]
Morphological properties were investigated with scanning electron microscopy (SEM). As shown in Figure 2 (a), it depicts that the synthesized RGO has a nanosheet structure like graphene with wrinkles and folded regions. Figure 2(b) shows the macroscopic physical pellet samples for thermoelectric characterization.

From Hall measurement at room temperature, n-type RGO composite pellet has a carrier concentration about 1.95x10$^{20}$ cm$^{-3}$, a resistivity of 2.5x10$^{-6}$ ohm-cm, and a mobility of 12.7 cm$^2$/V-s.

[Conclusion]
We made nanosheet structures of n-type RGO by hydrothermal method and measured its carrier concentration and mobility. Currently, we are investigating Seebeck coefficient and thermal conductivity of synthesized RGO.