Study on the conducting polymer-based organic thermoelectric generators

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Recent progress in polymer-based organic thermoelectric generators (OTEGs) has yielded remarkably high performance. These achievements, with performance that can be comparable to inorganic materials, are the result of high *Seebeck* coefficient, high electrical conductivity, and low thermal conductivity obtained by chemically controlling the material's redox level.

Unfortunately, thermoelectric properties that had been reported in these papers are often over-evaluated. Because organic materials have low electrical conductivity and usually are used very small scale samples compared to inorganic materials, it is easy to misestimating temperature gradients and thermoelectric voltages. Therefore, commercial thermoelectric measurement system are not proper to organic materials. In this study, new measurement system for measuring the accurate thermoelectric properties of organic materials was introduced. In order to estimate the accurate *Seebeck* coefficient, temperature and thermoelectric voltage must be measured precisely. Fine *chromel* and *alumel* wires are the key of resolving these problems. **Fig.1** shows schematic and concept of contact-type thermoelectric measurement system. *Chromel* and *alumel* are the alloy known *Seebeck* coefficient (S_{Chr}= 22μV/K and S_{Alu}=-19μV/K) and well known as a material for forming a K-type thermocouple. In addition, two thermocouples that is consisted of *chromel* and *alume*l wires can measure the hot and cold sides of temperatures. Four *chromel* wires can be used as the electrodes to measure the resistance of samples. Eventually, the accurate *Seebeck* coefficient of samples can be calculated precisely and simultaneously. The red horizontal lines in **Fig. 2** converge to entire region of zero ideally when a temperature gradient is applied reference samples. These results mean that thermoelectric voltage cancels each other at hot and cold side of reference samples. On the other hands, the blue slash line shows the results according to the difference of *Seebeck coefficient* between *chromel* and *alumel*. From the these results, calculated *Seebeck* coefficients of *Chromel*, *Alumel* and other reference samples are in good agreement with literature values in the actual measurement.

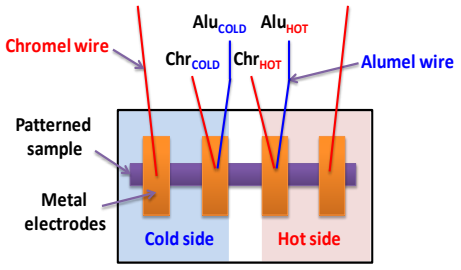

Fig.1 Schematic of contact-type

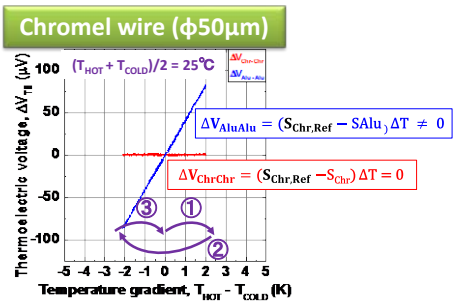

Fig.2 The result of thermoelectric voltage (ΔV_{TE}) when the temperature gradient (ΔT) is applied to Chromel wire used as a reference sample.

Therefore we can conclude that our new measurement system can be reliable and can measure the thermoelectric properties of small scale organic materials.