Control of Thermoelectric Conversion properties of Organic Thin Films by Polymerization

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Thermoelectric conversion devices have been expected to be one of the ubiquitous power sources used in a future advanced global network, such as Internet of Things (IoT). Although a thin film of fullerene C_{60} molecules is one of candidates of novel flexible thermoelectric materials because of its giant Seebeck coefficient S (S = 100-150 mV/K) at room temperature (RT), improvement of its very low electrical conductivity σ ($\sigma < 10^{-5}$ $\Omega^{-1}cm^{-1}$) is required for practical use. However, it is generally difficult to realize thermoelectric materials exhibiting large values of S and σ simultaneously owing to the general trade-off relationship between them in conventional materials. In this presentation, I have demonstrated that the electrical conduction of C_{60} films can be improved with maintaining a giant value of S of the films by formation of the intermolecular covalent bonds between adjacent C_{60} molecules *via* [2 + 2] cycloaddition reaction. The thermoelectric properties of thin films of C_{60} and polymerized C_{60} molecules were evaluated using micro-gap electrodes where gradient of temperature was locally generated in the gap. Using this methodology, we have also found possibility that the giant value of S of C_{60} films originates from geometrical defects such as crystalline grains boundary.