Thermoelectric Figure of Merit of τ-type Conductors of Several Donors

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It is known that τ-type two-dimensional conductors show relatively large thermopower S in the order of -100 $\mu V \cdot K^{-1}$, while their electrical resistivity ρ is often metallic [1]. This is explained on the basis of "Pudding Mold"-type band [2]. Thermoelectric dimensionless figure of merit $ZT=S^2T/\rho\kappa$ is therefore expected to be large due to the large S in combination with low thermal conductivity κ of organics. To explore organic conductors with large ZT, κ, S and ρ were simultaneously measured for τ-type conductors with changing donors and anions, namely, for τ-$(D)_2(X)_{1+y}$, where D=EDO-*S*,*S*-DMEDT-TTF, P-*S*,*S*-DMEDT-TTF and EDT-*S*,*S*-DMEDT-TTF and so on; X=$AuCl_2$, $AuBr_2$ and AuI_2, respectively.

Figure 1 shows the results for five τ-type conductors ever studied. The largest ZT up to now is 0.042 observed for the D=EDO-*S*,*S*-DMEDT-TTF and X=$AuBr_2$ salt at 130 K. This ZT value is comparable to the largest ZT ever observed in organic polymers. On the other hand, the P-*S*,*S*-DMEDT-TTF salt shows ZT~10^{-4}, about 1/100 of the previous one. It was found that very larger κ of 10 $W \cdot K^{-1} \cdot m^{-1}$ makes ZT low in the P-*S*,*S*-DMEDT-TTF salt, while κ is in the order of 1 $W \cdot K^{-1} \cdot m^{-1}$ for the other ones. This suggests unexpectedly large variation in ZT is realized by substituting donor molecules.

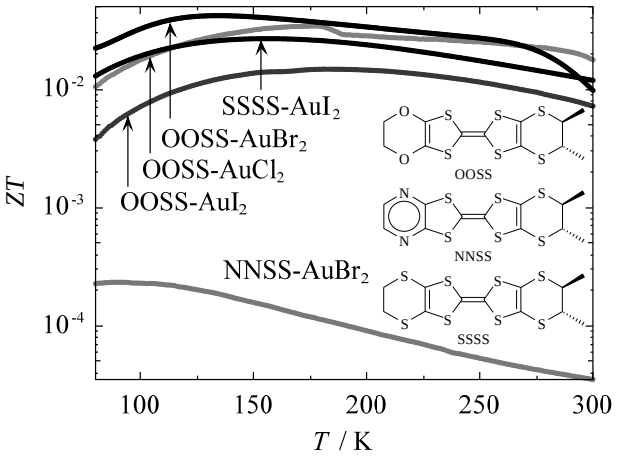

Fig. 1. Temperature dependence of dimensionless thermoelectric figure of merit ZT of τ-$(D)_2(X)_{1+y}$, where D=OOSS (EDO-*S*,*S*-DMEDT-TTF), NNSS (P-*S*,*S*-DMEDT-TTF) and SSSS (EDT-*S*,*S*-DMEDT-TTF); X=$AuCl_2$, $AuBr_2$ and AuI_2, respectively.

[1] H. Yoshino *et al.*, J. Therm. Anal. Cal. 92 (2008) 457.
[2] K. Kuroki and R. Arita, J. Phys. Soc. Jpn. 76 (2007) 083707.