

Violation of the Wiedemann-Franz law in quasi-one-dimensional organic crystals

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Abstract

The charge and energy transport in some highly conducting quasi-one-dimensional organic crystals is studied. Two electron-phonon interactions and scattering on impurity are considered. It is found that the Wiedemann-Franz law is strongly violated. The Lorentz number is diminished for a large interval of Fermi energy: (1) due to faster decrease in thermal conductivity than the electrical conductivity when the conduction band width is decreased, and (2) due to strong dependence of relaxation time on carrier energy. The Lorentz number becomes dependent on crystal purity and may be reduced by up to ten times and even more in comparison with ordinary materials. This is favorable for the increase of thermoelectric figure of merit ZT . It is predicted that in really existing crystals of tetrathiotetracene-iodide, when after the optimization of carrier concentration $ZT=1.4$ is expected, the Lorentz number is reduced by 1.6 times with respect to the usual value.