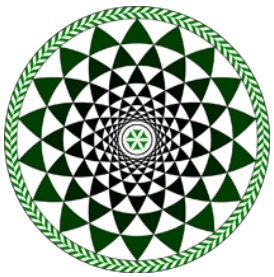

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Peculiar low-energy phonon excitations in organic crystal with strong charge fluctuations

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The influence of charge fluctuation on physical properties is one of the hot topics in the field of organic conductors. In particular, in the study of superconductors in the vicinity of charge-ordered insulating phase, various discussions about the relationship between the formation mechanism of superconductivity and charge fluctuation have been made from the viewpoint of both theoretical and experimental. From the heat capacity measurement of single crystal of θ-(BEDT-TTF) $_2$CsZn(SCN)$_4$ (abbreviated as θ-CsZn), we have found the boson peak-like anomalies in heat capacity at low temperature in some compounds with strong charge fluctuations. Although details of this bosonic peak have been not clear, it has been considered as the low energy excitation caused by charge fluctuation and strong phonon-electron coupling. Therefore, in this research, in order to clarify the relationship between electronic state and phonon state, we performed the thermal conductivity measurement, which is an efficient method to observe the state of phonon directly, for several organic conductors with strong charge fluctuations.

To measure thermal conductivity, we developed a thermal conductivity measurement system for tiny single crystals. We attached the both end of the tiny single crystal sample to the two temperature regulated plates using thin gold wires. The temperature differences between the plates were measured by two different thermometers.

The temperature dependences of the thermal conductivity of θ-CsZn was successfully conducted. In ordinary well ordered crystals, the thermal conductivity has a peak structure due to phonon-phonon scattering (Umklapp process) around 10 K. However, this material does not have such a peak structure and monotonically increases with increasing temperature. And there is a plateau structure of thermal conductivity between 3 K and 7 K. In addition, the temperature dependence of the thermal conductivity around 1 K was followed to the T^2 dependence. These features are typical for glassy material like SiO_2 glass. We thought that the charge ordered domains that exist spatially heterogeneously act as an effect of adding disorder to the lattice and as a result the crystal structure and its phonon property was changed into glassy state. And if assuming such scenario, we can understand the boson peak in the heat capacity at low temperature as the anomalous temperature dependence of glassy materials. We analyzed these results by the soft potential model, which is used to explain the physical properties of glassy material, and we found this model agree with the temperature dependence of thermal conductivity and heat capacity of this compound. The systematic study including charge ordered compounds with the same crystal packing is presented.

Primary author: Mr NOMOTO, Tatsuya (Department of Chemistry, Graduate School of Science, Osaka University, Toyonaka, Osaka, Japan)

Co-authors: Dr KRIVCHIKOV, Alexander I. (B. Verkin Institute of Low temperature Physics and Engineering, Kharkov, Ukraine); Dr AKUTSU, Hiroki (Department of Chemistry, Graduate School of Science, Osaka University, Toyonaka, Osaka, Japan); Dr YAMASHITA, Satoshi (Department of Chemistry, Graduate School of Science, Osaka University, Toyonaka, Osaka, Japan); Prof. NAKAZAWA, Yasuhiro (Department of Chemistry, Graduate School of Science, Osaka University, Toyonaka, Osaka, Japan)

Presenter: Mr NOMOTO, Tatsuya (Department of Chemistry, Graduate School of Science, Osaka University, Toyonaka, Osaka, Japan)

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