

Inelastic X-ray Scattering Studies on Organic Conductor TTF-TCNQ

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The tetrathia-fulvalence tetracyanoquinodimethane (TTF-TCNQ: $C_6S_4H_4-C_{12}N_4$) is a well-known, typical low-dimensional organic conductor. This sample has intensively been studied in both experiment and theory so far. Nevertheless, x-ray spectroscopy such as x-ray absorption [1] and photo-emission spectroscopy [2], still remains several puzzles. Those spectra have not been reproduced by theory and not been understood well. In this study, we measured inelastic x-ray scattering (IXS) spectra at the carbon K-edge to obtain a clue to solve those puzzles. IXS spectrum provides similar information to conventional x-ray absorption but it includes a valuable parameter, i.e., the momentum transfer (q). In high q , IXS can observe non-dipole transitions as well as dipole transitions.

In the experiment, the incident photon energy (E) was scanned from 10143 eV to 10203 eV, while the detected photon energy (E_0) was fixed at 9883 eV. Using a Si 400 four bounce monochromator and nine Si 555 (diced) spherical crystals, we achieved an energy resolution of 170 meV. The powder sample was pressed into a disk shape with an 11-mm diameter and a 1.5-mm

thickness. The beam position on the sample was consecutively moved every 50 seconds to avoid radiation damages. The IXS spectra were measured at three q -points, 26 nm^{-1} , 50 nm^{-1} and 94 nm^{-1} .

At $q = 26\text{ nm}^{-1}$, we observed a spectrum very similar to that in the soft x-ray absorption experiments [1]. On the other hand, at $q = 96\text{ nm}^{-1}$, we could not find a clear edge structure because of a large back ground due to Compton scattering. During the measurement at $q = 50\text{ nm}^{-1}$, unfortunately, a hard-disk of the PC that was controlling the spectrometer was suddenly damaged. We lost all the data that were collected in this beamtime. However, it has been clear that this experiment is possible. We are confident that we will have high-quality data if we try this experiment once again.

[1] J. Fraxedas et al. PRB 68(2003)195115

[2] F. Zwick et al. PRL 81(1998)2974