Phonon Modes in a Molecular Dimer-Mott Insulator β'-(BEDT-TTF)$_2$ICl$_2$ Studied by Inelastic Neutron Scattering

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Recently it has been reported that a molecular dimer-Mott insulator β'-(BEDT-TTF)$_2$ICl$_2$ is a candidate of a quite new type of ferroelectric system which shows a relaxor-like dielectric response [1]. The system exhibits a glassy ferroelectric state associated with charge disproportionation within the BEDT-TTF dimer below T_c = 62 K and long-range antiferromagnetic order below T_N = 22 K. We have performed inelastic neutron scattering experiments on this system by using a chopper spectrometer AMATERAS installed at BL14 in MLF, J-PARC.

The phonon intensity at ~18 and ~21 meV decreases with lowering temperature, while that at ~13.5 meV increases (Fig. 1(a)). We have already found that a period-doubled optical phonon mode at 4.2 meV is enhanced below around T_c and then is suppressed below T_N, indicating significant relationship to both charge and spin dynamics. In sharp contrast to this low-energy mode, the intensity of the optical mode at ~18 meV (arrow in Fig. 1(a)) decreases below T_c to reach a constant value at a low temperature (Fig. 1(b)). In the presentation, we show the observed phonon modes in this system and their relationship with charge and spin degrees of freedom.

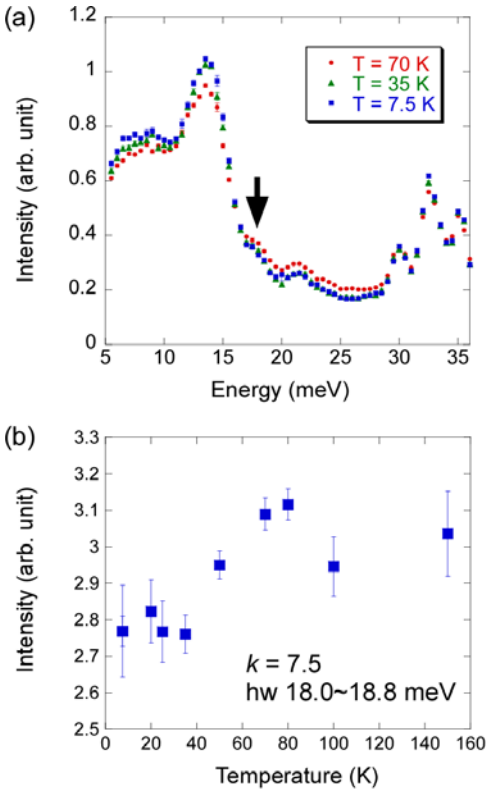

Fig. 1 (a) Energy cuts obtained at 7.5, 35 and 70 K and (b) temperature dependence of intensity of the optical phonon mode at ~18.5 meV.

Reference

[1] S. Iguchi et al., Phys. Rev. B **87**, 075107 (2013).