

Optical control of effective on-site Coulomb repulsion in organic dimer Mott insulator

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κ -type [bis(ethylenedithiolo)]-tetrathiafulvalene (BEDT-TTF or simply ET) salt ET_2X (X denotes counter anion) is a typical two-dimensional organic Mott insulator. The ET layer has a unit consisting of a pair of ET molecules (ET dimer), and the HOMO band is effectively half-filling. If an effective on-site Coulomb energy $U_{\text{dimer}} > 4t$ (t represents interdimer transfer integral), then a dimer Mott insulator is formed. The band width controlled phase diagram consisting of Mott insulator, metal, and superconductor with characteristic curved phase boundary, is drawn by changing chemical pressure or by application of external pressure.

On the other hand, optical excitation is another available method for an insulator-to-metal (I–M) transition in organic conductors [1-3]. In this study, photo-induced insulator to metal transition (PIMT) was demonstrated in a dimer-lattice Mott insulator, κ -(ET)Cu[N(CN)₂]Br under intradimer excitation. Finite buildup times (ca. 1 ps) of PIMT and related coherent phonon in the photo-induced metallic state are indicative of the intradimer molecular displacement, which reduces U_{dimer} on each ET dimer of ca. 0.5%. Such small molecular displacement upon PIMT enables detection of oscillating domain wall motion of the photo-induced metallic state with a period of 240 ps.

[1] S. Iwai et al. Phys. Rev. Lett. 98, 097402(2007).

[2] S. Iwai et al. Phys. Rev. B. 77, 125131(2008).

[3] K. Yamamoto et al. J. Phys. Soc. Jpn., 77, 074709(2008).