Electron-phonon coupling in a molecular crystal κ-(BEDT-TTF)2Cu2(CN)3 measured by Resonant Inelastic X-ray Scattering

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Effects of the electron-phonon coupling are omnipresent in condensed matter physics, the most spectacular being the conventional superconductivity. But, there are only few experimental techniques permitting to measure its strength. Improvement of the resolving power of the resonant x-ray scattering (RIXS), promotes it to an excellent technique for direct electron-phonon coupling measurement, which is at the same time element-specific and momentum-resolved.

We measured RIXS of a molecular crystal κ-$(BEDT\text{-}TTF)_2Cu_2(CN)_3$. This charge transfer salt is known as the most prominent spin-liquid Mott insulator. Moreover, a low pressure of the order of 1 kbar suppresses its Mott insulating state and establishes a superconducting state. It is constituted of layers of organic BEDT-TTF molecules separated by $Cu_2(CN)_3$ anion planes. Understanding how the lattice dynamics couples to its charge and spin degrees of freedom is of primary importance, as neither the spin-liquid state nor the superconducting state are not yet completely understood.

N K edge RIXS spectra of κ-$(BEDT\text{-}TTF)_2Cu_2(CN)_3$ show a clearly resolved vibrational progression in the quasi-elastic part of the spectra. The separation of harmonics of about 250 meV is attributed to the excitation of the CN stretching mode. After IR and Raman techniques, the electron-phonon coupling strength of this Einstein phonon is considered to be negligible. Using RIXS, we estimated the value of its dimensionless electron phonon coupling constant with success.