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Origin of Charge Density Wave Formation in Insulators from a High Resolution Photoemission Study of $BaIrO_3$

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We investigate the origin of CDW formation in insulators by studying $BaIrO_3$ using high resolution (1.4 meV) photoemission spectroscopy. The spectra reveal the existence of localized density of states at the Fermi level, E_F, in the vicinity of room temperature. These localized states are found to vanish as the temperature is lowered thereby, opening a soft gap at E_F, as a consequence of CDW transition. To our knowledge, for the first time, we have demonstrated directly the evolution of charge density wave due to localized electronic states. In addition, we find that the spectral density of states exhibit a $(E - E_F)^{3/2}$ dependence, which reveals the role of magnetism on the electronic structure in the vicinity of Fermi level. This signals an intimate relationship between ferromagnetism and charge density wave in this system, rather than well-known Coulomb repulsion effect. Also, Ba core level spectra surprisingly exhibit an unusual behavior prior to CDW transition suggesting significant modification in Ba-O covalency. The observation of these profound changes prior to the formation of charge density wave poses a new question with respect to the role of precursor effects.

Keywords : Charge density wave, high resolution photoemission