

Evidence of chiral charge-density-waves in TiSe₂ by using STM and optical ellipsometry

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We report a chirality of Charge-Density-Waves (CDW) in 1T-TiSe₂ by using STM measurement. We found that CDW intensity I_{q_i} ($i = 1, 2, 3$) is different by triple Q direction in STM measurement. The amplitude of tunneling current contributed from CDW becomes $I_{q_1} : I_{q_2} : I_{q_3} = 1 : 0.7 : 0.5$. Then we found two state. Three sets of intensity peaks of CDW decrease clockwise ($I_{q_1} > I_{q_2} > I_{q_3}$) or counterclockwise ($I_{q_1} > I_{q_3} > I_{q_2}$) from Fourier transformation of STM images measured in different sample. We saw that this difference comes from CDW stacking along c-axis at intervals of $2c_0/3$ (c_0 is lattice constant). There are chirality by way of twisted stacking such as cholesteric liquid crystals (Fig.1). To confirm the chirality of CDW, we measured transient reflectivity signals in TiSe₂ by linear polarized probe pulse. The optical property reveals 2-fold symmetry. These results are consistent with that of the STM measurement. We give a first evidence of existence of chirality in two-dimensional CDW system.

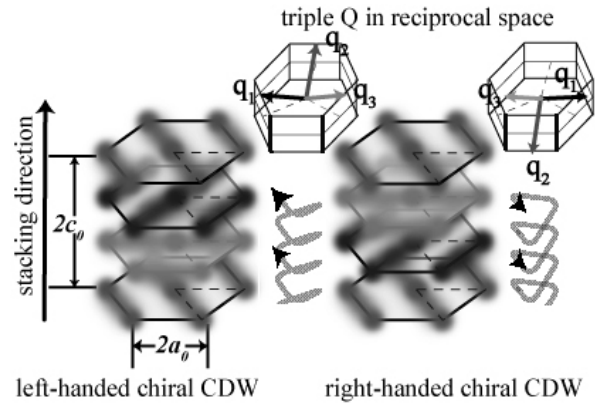


Fig.1: Left-handed chiral CDW and right-handed chiral CDW in real space are schematized. Charge density are described as dark gray part. Density peaks of three CDWs are shifted at intervals of $2c_0/3$. Triple Q vectors are illustrated in Brillouin zone. Each nesting vectors, for example $\mathbf{q}_1 = \mathbf{a}^*/2 + \mathbf{c}^*/2$, include c axis component so that density waves run diagonally.

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