The three-dimensional charge-density-wave compound CuV_2S_4

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The classical charge density wave (CDW) develops in so-called quasi-one-dimensional (1D) electronic crystals that contain weakly interacting metallic chains. The CDW state was originally believed to be stabilized by the Peierls mechanism: nesting by a single wave vector (**q** vector) of flat, co-planar portions of the Fermi surface drive the system into a charge-modulated state with wave vector **q**. The vector **q** is related to the Fermi wave vector and it is generally incommensurate to the crystal lattice. The CDW state possesses a gap in the one-electron density-of-states (DOS). Therefore, the CDW phase transition is a metal to semiconductor transition. The CDW in the conduction band is intrinsically coupled to a periodic lattice distortion (PLD) of the same period, which can easily be measured by diffraction techniques. This simple interpretation of the CDW state has recently been questioned, and the role of electron-phonon interactions has been stressed. Alternative mechanisms will be required for so-called strongly coupled CDW systems, which lack a clear anisotropy of their metallic electrical conductivity and which lack obvious 1D features of their crystal structures. Examples of three-dimensional (3D) CDW materials include $RNiC_2$, $R_5Ir_4Si_{10}$ and $R_2Ir_3Si_5$ (R = rare earth element) [1, 2]. Here, we will discuss 3D CDW systems, with emphasis on the incommensurate CDW in the spinel compound CuV_2S_4 [3]. CuV_2S_4 has cubic symmetry Fd3m, and thus lacks a manifest direction in its crystal structure, while the electrical conductivity is isotropic. At T_{CDW} = 90 K a phase transition commences towards a 1D CDW state with orthorhombic symmetry and modulation wave vector **q** = (3/4+δ, 3/4+δ, 0) [3]. We will present an accurate structure model for the CDW state and provide a discussion of the origin of CDW formation in CuV_2S_4.

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