

ANGLE-RESOLVED PHOTOEMISSION STUDY OF QUASI-ONE-DIMENSIONAL β' -Cu_xV₂O₅ (x=0.33 ~ 0.65)

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β' -Cu_xV₂O₅ is a quasi-one-dimensional (quasi-1D) oxide that undergoes a metal to insulator transition (MIT) when x decreases from 0.65 to below 0.60 [1]. It becomes a superconductor below 6K under pressure around 3GPa [2]. In the insulating phase X-ray studies [1, 3] show various superstructures that are generally attributed to the ordering of the Cu ions in the V₂O₅ tunnel structure. In the metallic phase (x ≥ 0.60), the electrical resistivity [1] along the chain direction is 30 times larger than that across the chain direction, making this material suitable for studies of quasi-1D electronic structures.

In 1D, the canonical Landau Fermi liquid theory and its quasi-particle description of interacting electrons breaks down and is replaced by Luttinger liquid (LL) theory [4]. In the LL, there exist no quasi-particle excitations, only collective spin and charge fluctuations called spinons and holons. In consequence the **k**-resolved single-particle spectral function, measured by angle-resolved photoemission spectroscopy (ARPES), shows spinon and holon features and the **k**-integrated spectral function decays to the Fermi energy as a power of the so-called anomalous exponent α , a key parameter of the LL theory and the ARPES spectrum is also quantum critical. Li_{0.9}Mo₆O₁₇ [5, 6] is the only quasi-1D material now known that exhibits these LL spectral characteristics.

With a view to finding a second quasi-1D LL material, we have measured ARPES spectra of β' -Cu_xV₂O₅ in both metallic (x=0.60, 0.65) and insulating (x=0.33, 0.55) phases. In the metallic phase only, we observe around the Γ -point of the Brillouin zone a single band crossing the Fermi energy along the chain direction. Fermi surface (FS) intensity maps have clear 1D character as in Li_{0.9}Mo₆O₁₇. Furthermore, the size of the FS changes according to the concentration of the dopant, and the estimated number of electrons from a simple 1D model agrees well with the number of Cu ions. Angle-integrated spectra show a clear indication of the MIT. Nonetheless the intensity near E_F is heavily suppressed in the metallic phase, just as in the PES spectra of Li_{0.9}Mo₆O₁₇ and certain other low dimensional oxides [6]. Fitting the angle-integrated spectra of the metallic phase to a finite temperature LL theory [7] gives $\alpha=0.9$, the same value as that of Li_{0.9}Mo₆O₁₇ near 300K. ARPES lineshapes remain to be studied.

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