The Angle-Resolved Photoemission Study for One-Dimensional Chain Cuprate $LiCu_2O_2$

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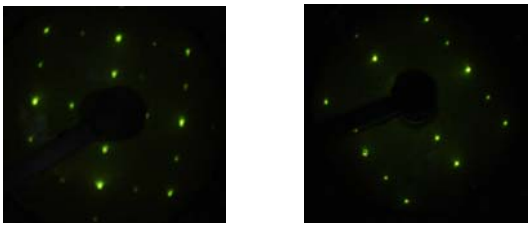
The physical properties of one dimensional (1D) copper oxides have much interest due to correlated with high-Tc superconductor. The corner-sharing chain with 180° Cu-O-Cu bonds and edge-sharing chain with nearly 90° Cu-O-Cu bonds show very different electronic and magnetic properties. Antiferromagnetic ordering with corner-sharing chains was found on most samples, such as Sr_2CuO_3 and Sr_2CuO_2. In contrast, a frustrated effect was observed on edge-sharing compounds due to competition between ferromagnetic and antiferromagnetic exchange. $LiCu_2O_2$ is a quasi-1D magnetic material with bi-layers of edge-sharing Cu-O chains. The geometric structure makes $LiCu_2O_2$ a candidate to study a spin-ladder or zig-zag chain system.

The $LiCu_2O_2$ single crystals were grown by the traveling solvent floating zone technique (TSFZ) at 1 atm O_2 and air. The composition analysis was determined by the inductively coupled plasma atomic emission spectrometer (ICP-AES). The crystals were in-situ cleaved at room temperature (RT) at a base pressure of $9x10^{-11}$Torr. The low energy electron diffraction (LEED) was used to check sample surfaces and orientation. Fig.1 (a) and (b) show the LEED patterns of cleaved (001) surfaces for crystals grown in air and O_2 atmosphere, respectively. A well-ordered single domain was observed on crystal grown in O_2 atmosphere, but twining domains appear on sample grown in air.



(a) (b)

Figure 1. The LEED pattern for crystal grown in air(a) and O_2 (b), a twining domain is observed on (a), which is the superposition of two orthogonal rectangular (a ~ 2b) pattern. (b) show a well-order single domain

The experiment was carried out at the National Synchrotron Radiation Research Center in Hsinchu, Taiwan using BL21B1 U9-CGM Spectroscopy Beamline. The photoemission spectra were measured in a UHV chamber equipped with a Scienta SES-200 hemispherical analyzer with ±8◦ collecting angle. The angular resolution of 0.25◦ was chosen for the angle-resolved measurements. All spectra were taken at RT to avoid charging effect. Fig. 2 shows photoemission spectra collected at the normal emission direction for different photon energy. A clear band disperses at deeper binding energy to indicate a 3-D behavior, but bands near Fermi edge are very localized. Fig. 3 shows angle-resolved photoemission spectra for crystal grown in air. A clear band disperses is observed near Fermi edge.

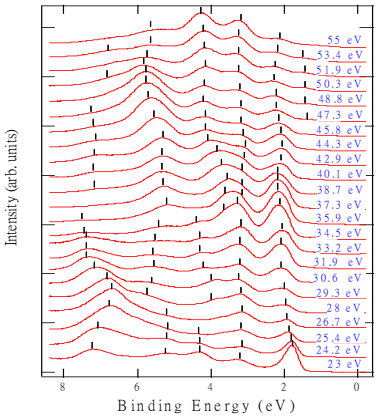


Figure 2. Angle-integrated photoemission spectra collected at the normal emission direction for different photon energy.

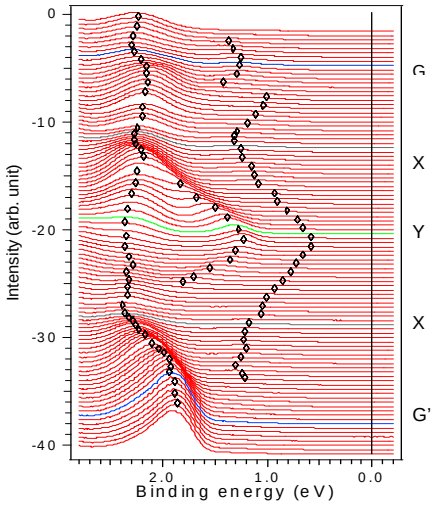


Figure 3. Angle-resolved photoemission spectra for crystal grown in air. The spectra were collected with the photon energy of 47 eV.