[III-11]

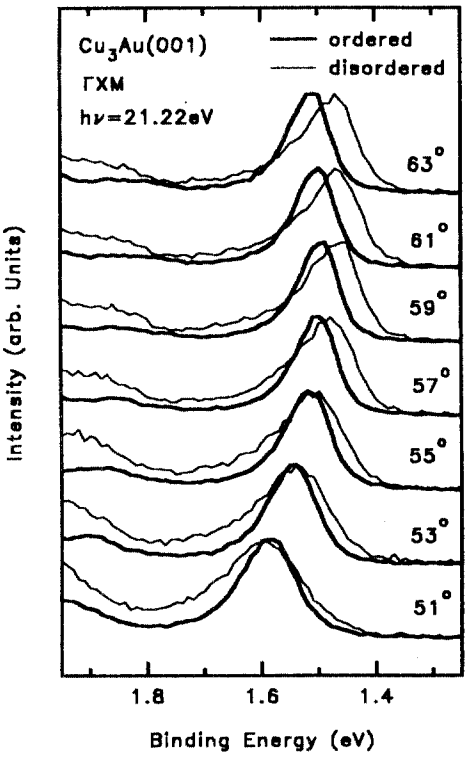
CHANGE OF THE QUASIPARTICLE STATE LIFETIME IN ORDER-DISORDER TRANSITION : TAMM SURFACE STATE OF Cu_3Au

Tschang-Uh Nahm and S.-J. Oh (Seoul Nat'l Univ., Korea)

In recent years, the linewidth and the lineshape of the photoemission spectroscopy (PES) have received much attention, because the lifetime of the quasiparticles can in principle be determined by the measurement of the linewidth of peaks in valence band angle-resolved PES. Ideally, this lineshpae is nothing but a spectral function of interacting Fermi liquids.[1] For disordered materials, there can be additional broadening due to disorder. Because of the lack of periodicity, the quasiparticle states are not well defined as in ordered phase, and even at the Fermi level, the states can sactter incoherently. The simple relation between the spectral weight and the ARPES spectra, however, does not hold for every case. The most important factor influencing the linewidth is the presence of surface which results in the loss of the conservation of the normal component of the wave vector, $k_\perp$.[2] Then the linewidths of photohole can be increased by the lifetime of final states. To remove contributions from the final state lifetime, perfect 2-dimensional system is the best candidate for the study of the lifetime broadening due to disorder.

In this work, we measure the bulk *sp* band and the Tamm surface state on $Cu_3Au(001)$ surface within the ΓXM plane with ultra-violet PES ($h\nu$ = 21.22 eV) in order to study the linewidth broadening due to order-disorder transition.

We find great reduction of the linewidth of the *sp* band in the ordered phase, but this reduction can be mostly explained with the bulk band structure, without relying on the additional broadening mechanism due to disorder. But as can be seen in figure, the spectra of the Tamm surface states of the disordered phase show the increase of the linewidth by 50 meV (full width at half maximum) compared with those of the ordered phase throughout the whole measured surface Brillouin zone, which can be attributed to the result of disorder. We fit the spectra of these surface states with spectral functions and find that the lineshapaes of the ordered phase can be reasonably represented by the spectral funciton with energy-dependent Lorentzian broadening. However, the simple additional Lorentzian broadening by ~50 meV does not fit the spectra of the disordered phase very well.



1. L. Hedin and S. Lundquist, in *Solid State Physics*, edited by H. Ehrenreich, F. Seitz, and D. Turnbull (Academic Press, New York, 1969), Vol.23.

2. N.V. Smith, P. Thiry, and Y. Pétroff, Phys. Rev. B **47**, 15476 (1993).