ESRF	**Experiment title:** **Resonant 2*p*3*s*3*p* and 2*p*3*p*3*p* Auger spectroscopy of CuO**	**Experiment number:** **HE428**
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Shifts: 18	**Local contact(s):** Nick Brookes	*Received at ESRF:*

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Report:

We have investigated the behavior of the 2*p*3*p*3*p* and 2*p*3*s*3*p* Auger lines of CuO and Cu_2O scanning the photon energy across the Cu L_3 resonance. For both samples, when the excitation energy is below the L_3 resonance, we observe the 2*p*3*p*3*p* and 2*p*3*s*3*p* peaks at constant binding energy. This behavior is typical of non-radiative resonant Raman scattering. If the photon energy is raised above the L_3 maximum, the two samples behave in different ways. In CuO, the Auger peaks are always observed at constant binding energy, while in Cu_2O their kinetic energy first reaches a maximum at correspondence with the absorption threshold, and then stabilizes at a value slightly higher than the off-resonance Auger peaks. These differences are interpreted in terms of the different electronic structure of the Auger intermediate state at resonance. In CuO, the intermediate state corresponds to a $2p_{3/2}$ core hole, with the Cu 3*d* band completely filled. On the contrary, in Cu_2O the intermediate state is represented by the combination of a $2p_{3/2}$ hole with a 4*sp* electron in strong interaction with the O-2*sp* valence band.

In CuO, for photon energies higher than 1.5 eV above the L_3 edge maximum, the constant binding energy radiationless Raman peaks are accompanied by constant kinetic energy replicas. These are attributed to the relaxation of the Auger intermediate state through electron-hole pair generation across the band gap of the material. Satellites that could be associated to relaxation processes involving energies smaller than the band gap are not resolved. No variation of the lineshape of the Auger peaks is observed as a function of the sample temperature, indicating that different densities of thermally accessible excitations do not have a strong influence on the recombination process of the core hole.

(Submitted to Physical Review B)

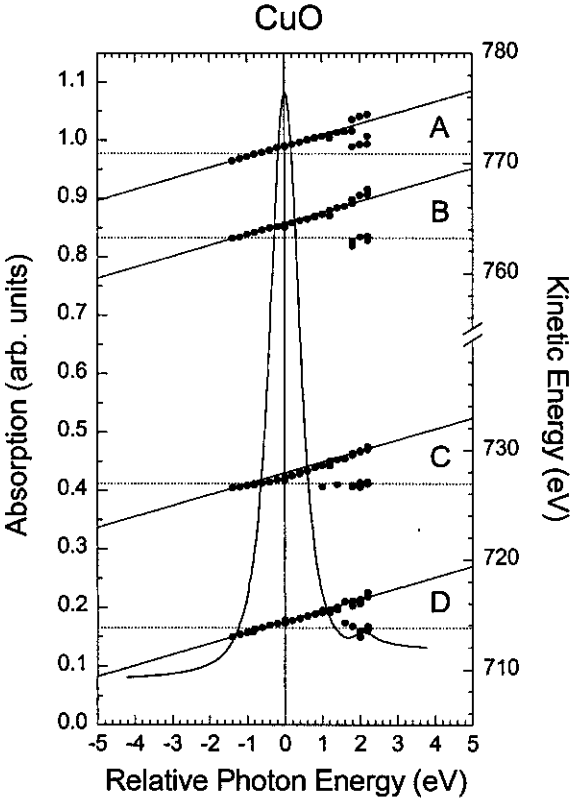

Figure 1: Kinetic energy of the $2p3p3p$ (peaks A and B) and $2p3s3p$ (peaks C and D) Auger lines in CuO as a function of the photon energy. The origin of the photon energy axis corresponds to the energy of the L_3 absorption maximum ($h\nu$ = 931.8 eV). The full straight lines correspond to constant binding energy points. The dashed lines have been traced through the points representing the positions of the peaks obtained at $h\nu = L_3 +$ 58.2 eV.

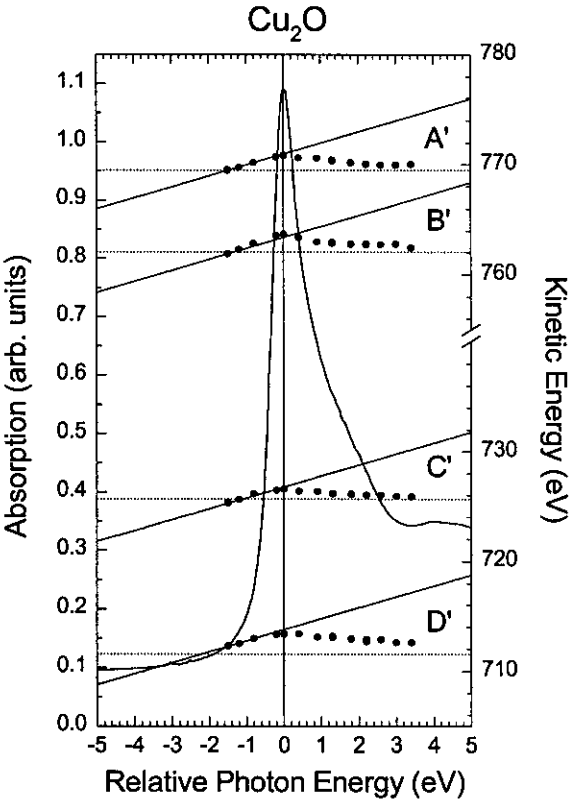

Figure 2: Kinetic energy of the $2p3p3p$ (peaks A' and B') and $2p3s3p$ (peaks C' and D') Auger lines in Cu_2O as a function of the photon energy. The origin of the photon energy axis corresponds to the energy of the L_3 absorption maximum ($h\nu$ = 933.6 eV). The full straight lines correspond to constant binding energy points. The dashed lines have been traced through the points representing the positions of the peaks obtained at $h\nu = L_3 +$ 76.4 eV.