SATELLITE STRUCTURE IN Cu^{2+} SPECTRA OF COPPEROXIDE SUPERCONDUCTOR

CONTENTS

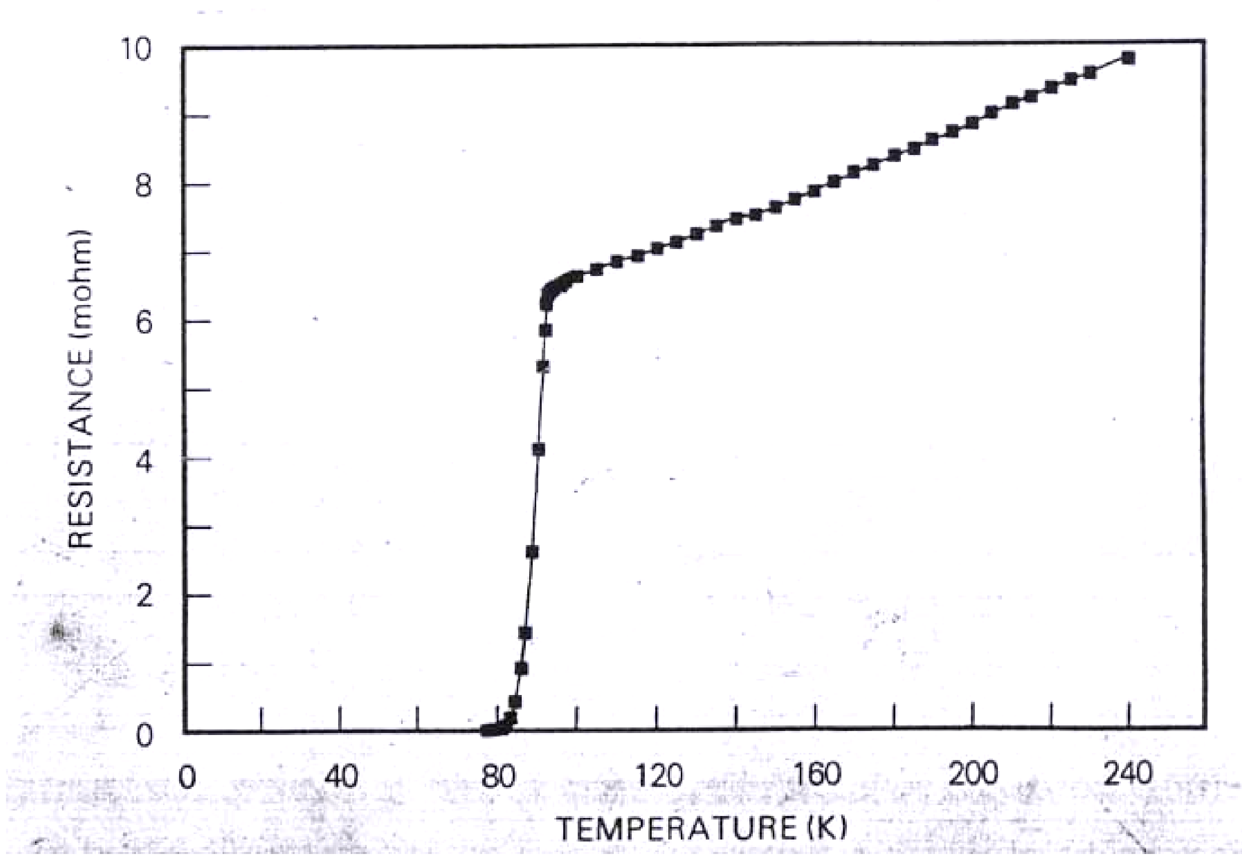
INTRODUCTION TO SUPERCONDUCTORS

1. Challenging task of material scientists

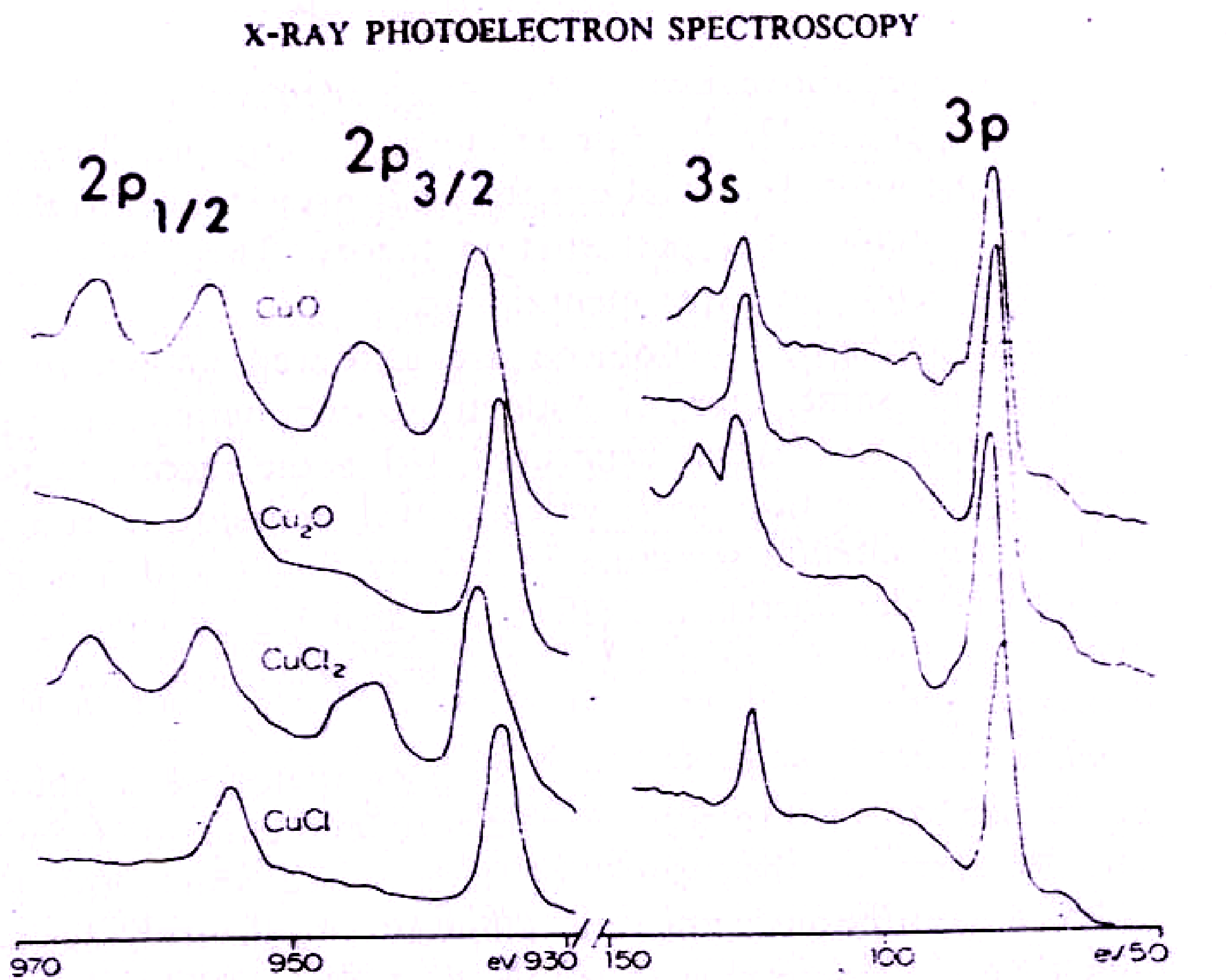
2. To obtain superconducting state reaching beyond the technological and phychological temperature.

3. New chemical compound system $(Y_{1-x}Ba_x)_aA_aD_y$ where x=0.4,a=2,b=1 and y≤4 with stable superconducting transition between 80 to 93 K.

4. The high temperature superconductivity in the La-Ba-Cu-O and La-Sr-Cu-O systems may be associated with interfacial effects arising from mixed phases.



Magnetic field effect on resistance



2p1/2,3/2 and 3S,3P core level spectrum from the Cu compounds CuO, Cu_2O, $CuCl_2$ & $CuCl$. The low energy satellites are very Strong in Cu^{2+}, $3d^9$ compounds and very weaken Cu^{+1} $3d^{10}$ compounds

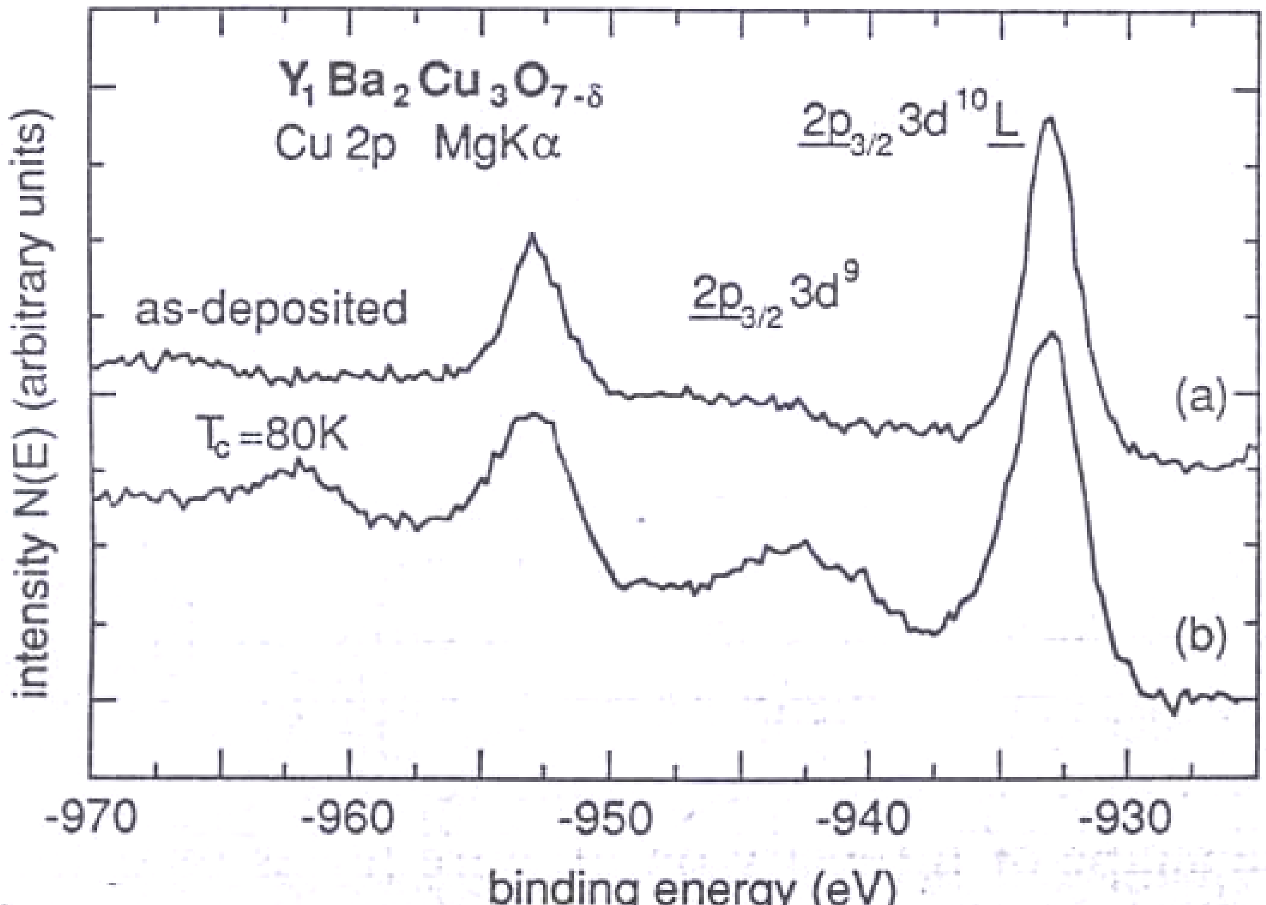
The strong satellite structure associated with the superconducting compounds indicating the presence of Cu^{2+} in the initial state.

Non-superconducting film doesn't produce the satellite structure and looks rather similar to Cu metal.

The formation of copperoxide is the single crucial step in the conversion to a superconductor.

When the film is deposited at room temperature the copper atoms are not oxidised.

Upon high temperature treatment the Cu atoms are oxidized in the superconducting phase and the spectrum has characteristic Cu^{2+} line shape.



Cu 2p core level spectra of YBCO, the change of satellite structure appear to correlate with the conversion from the amorphous, insulating phase to the crystalline,superconducting phase.

The XPS spectrum shows only subtle diffferences as a function of annealing temperature above 600 ^{o}C.

The satellite structure indicative of Cu $^{2+}$ appears in all the thin film spectra even for room temperature sample.

The apparent Cu valance changes little when these films undergo the drastic transition from amorphous, insulating phases to an ordered superconducting phase.

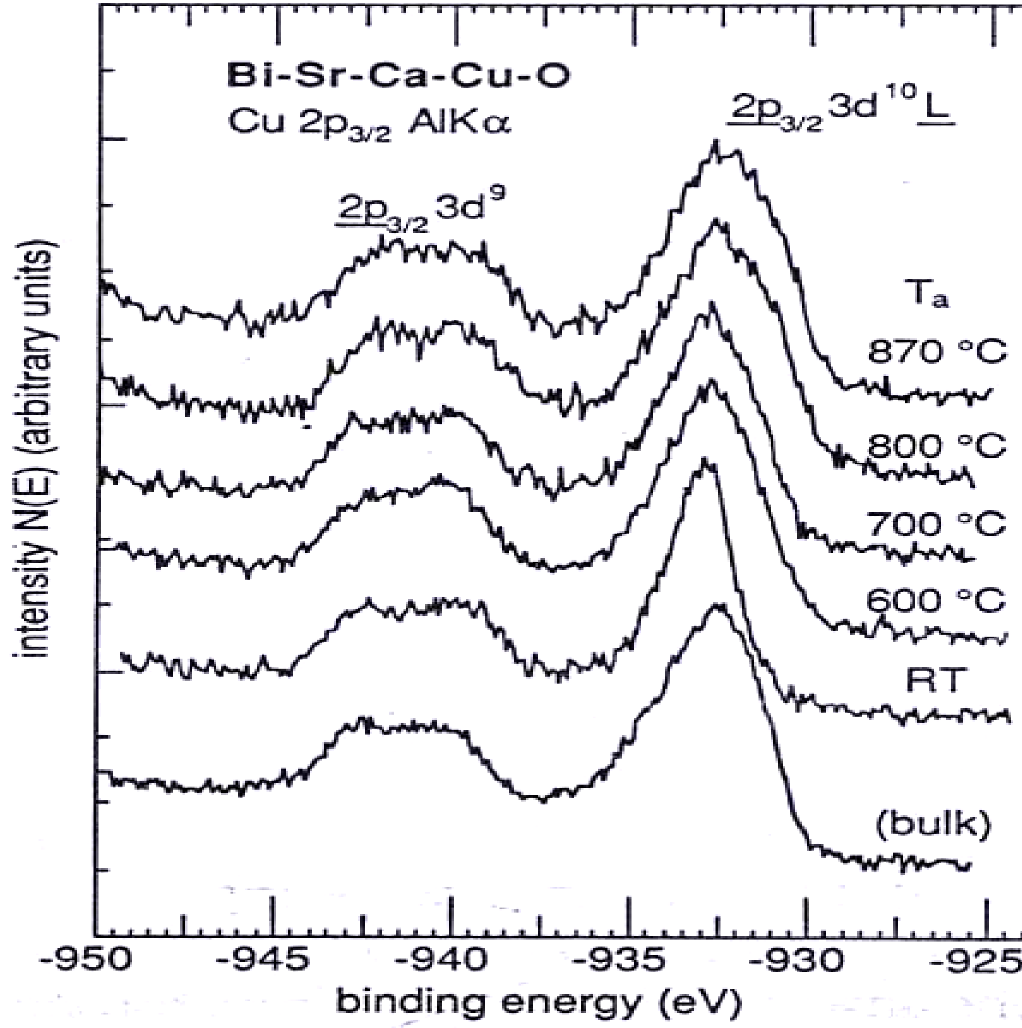
Such a result is quite different from what is generally believed to occur during the development of superconductivity in the Cu oxide.

Since suitable amounts of substitutions and/or vacancies in YBCO compounds will produce superconducting phase from insulating parent compounds.

The increase of Cu valance is required to generate superconductivity.

As a result the apparent Cu valance has been used to characterize superconductivity Cu oxides.

There is basically no difference for Cu atoms inside a room temperature deposited amorphous film whether it is a YBCO or BSCCO film.



Cu 2p core level spectra of Bi-Sr-Ca-Cu oxide thin film deposited at RT and then heat treated at different temperatures.

In a simple cluster model of the Anderson Hamiltonia, the Cu 2p line shape can be characterized using the following parameters

Cu-O Charge transfer energy Δ

Cu 3d-ligand hybridization T

and the Cu 2p hole and 3d hole coulomb interaction.

The energy separation of the satellite and the main core lines is.

$((\Delta-U_{cd})^2 + 4T^2)^{1/2}$.

CONCLUSIONS

The Cu valance in the BSCCO oxide systems undergoes very minor change during the transition from an amorphous insulator to an superconductor.

The invariance of the interactions visible to XPS indicates that the superconductivity in the high T_c superconducting oxides needs more than just interaction within localized Cu-O clusters.

REFERENCES

1. M.K.Wu, J.R.Ashburn, and C.J.Torng, Physical Review Letters, Vol.58, 908(1987).

2. J.J.Yeh, S.B.DiCenzo, E.H.Hartford, Jr.,M.Hong and R.J.Felder Applied Physics Letters,Vol.54.377(1989).

3. Basic concepts of X-ray photoelectron spectroscopy C.S.FADELEY