The study of oxygen concentration in $YBa_2Cu_3O_{6+x}$

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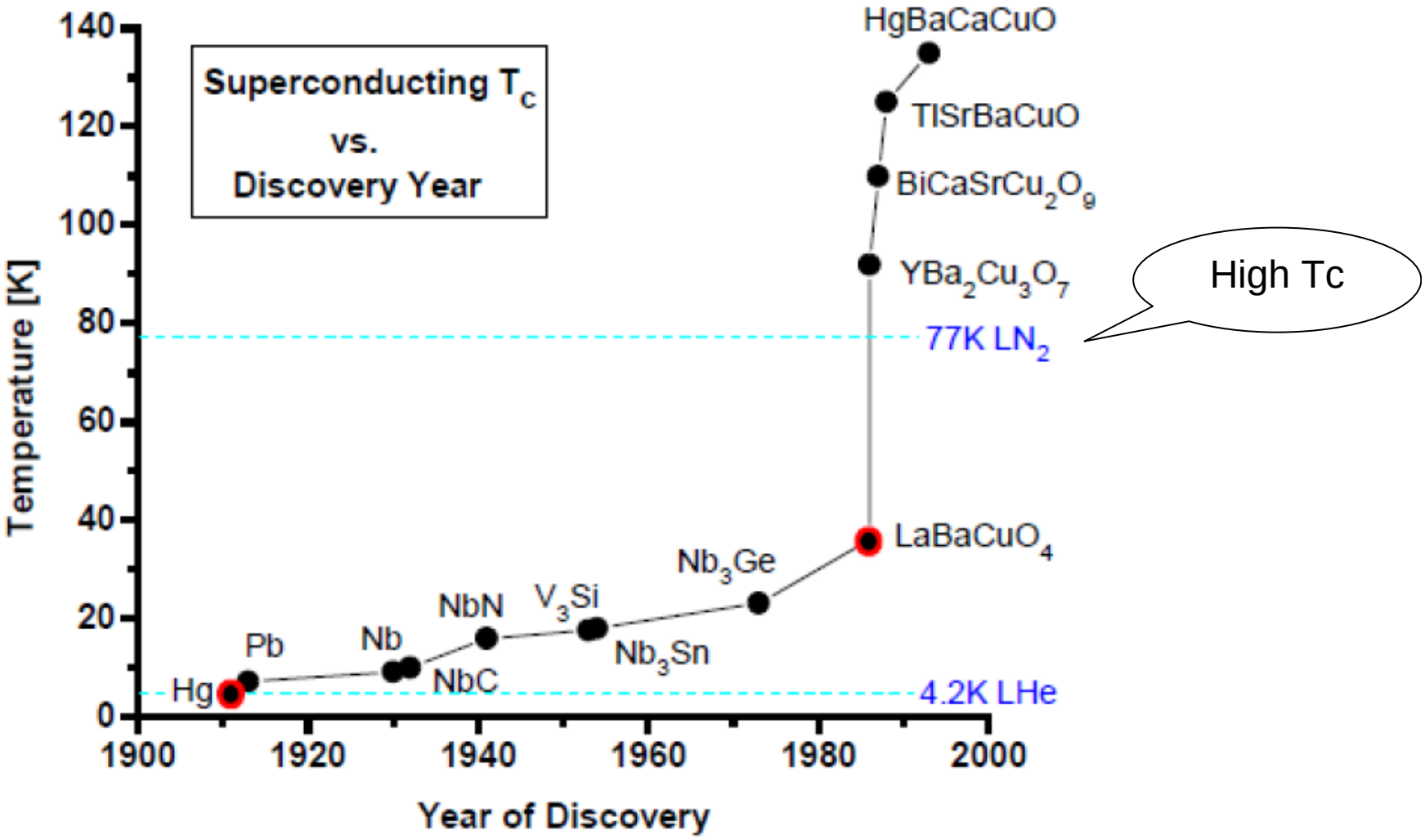
Outline

- Introduction of superconductor
- Introduction of YBCO
- Experiment & results
- Conclusion & acknowledgement

Introduction of superconductor



Introduction of superconductor

Elementary properties of superconductors:

1. Zero electrical DC resistance
2. Discontinuous of heat capacity

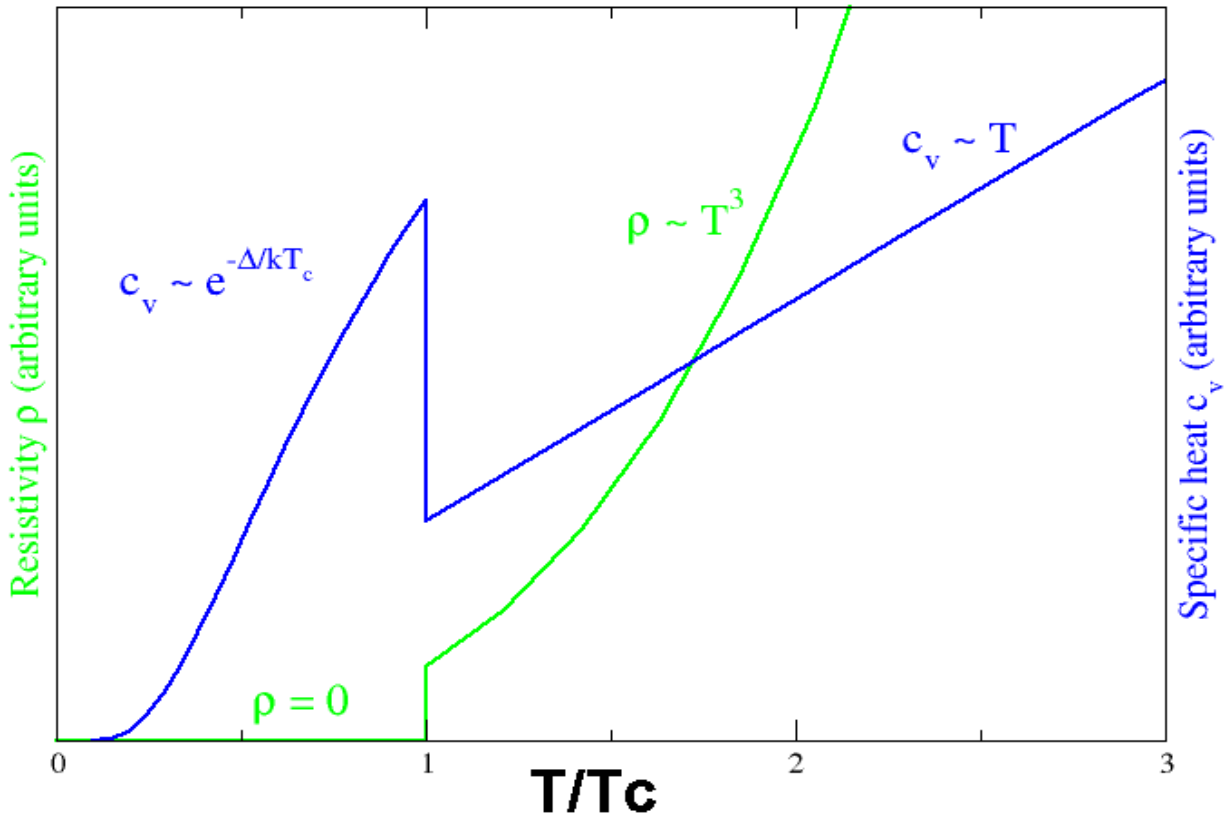


Figure1: Behavior of heat capacity (cv, blue) and resistivity (ρ , green) at the superconducting phase transition

Introduction of superconductor

3.Meissner effect

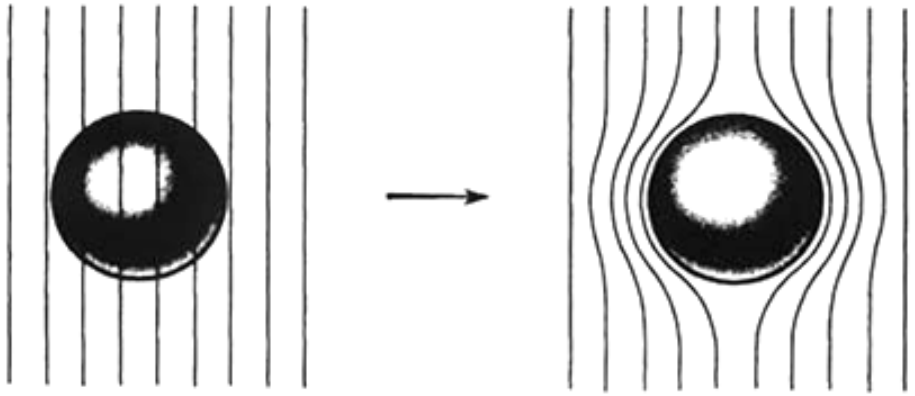
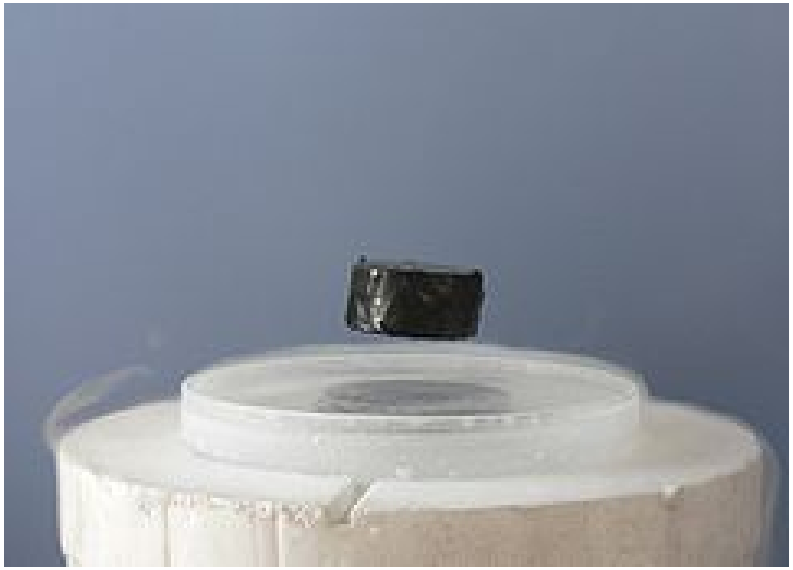


Figure2: Meissner effect

In Type I superconductors, superconductivity is abruptly destroyed when the strength of the applied field rises above a critical value *Hc* .

In Type || superconductors, raising the applied field past a critical value Hc_1 leads to a mixed state.
At a second critical field strength Hc_2, superconductivity is destroyed.



Introduction of YBCO

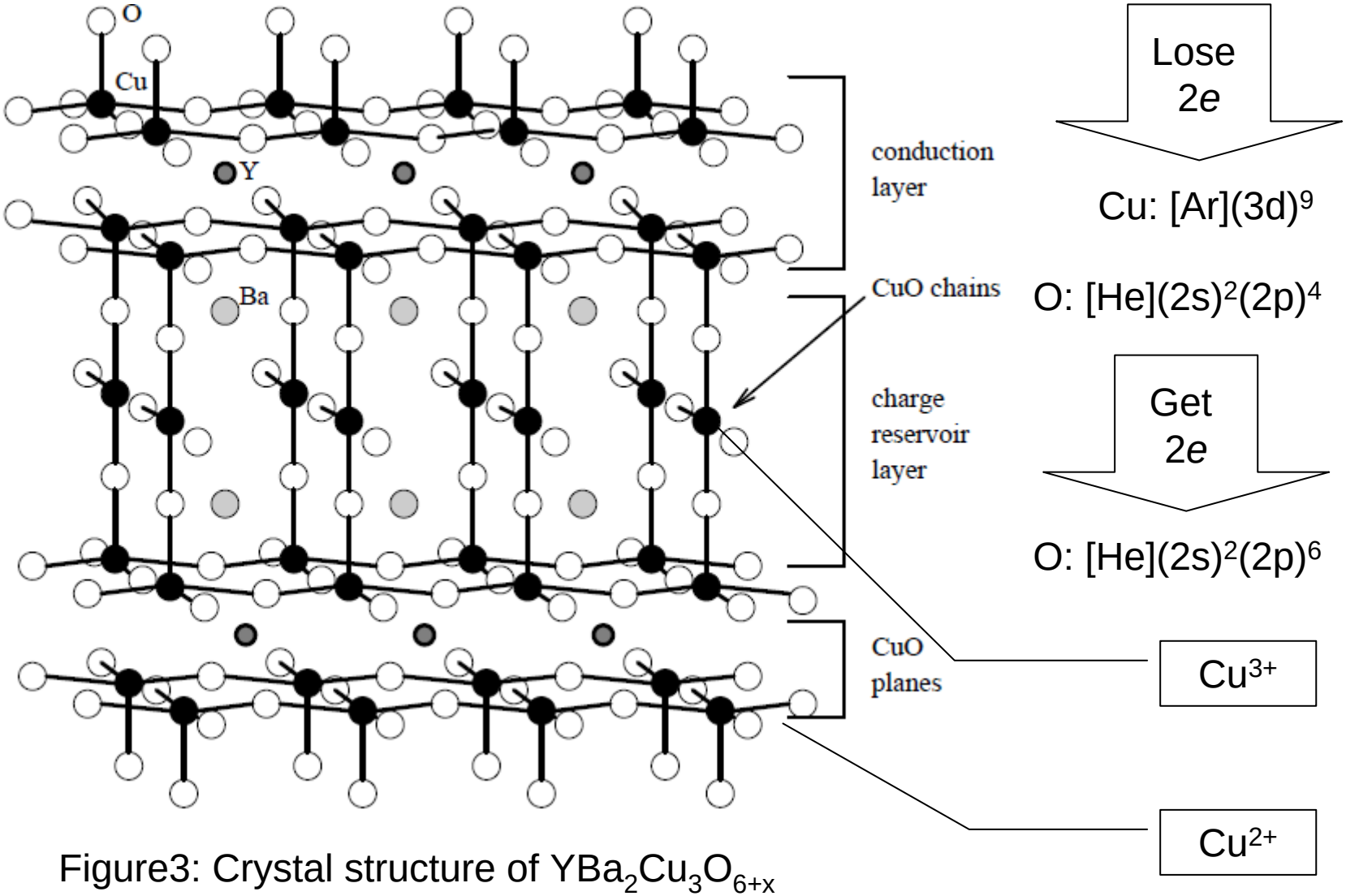


Figure3: Crystal structure of $YBa_2Cu_3O_{6+x}$

J.D.Jorgensen *et al*.

Experiment: growth and Meissner effect

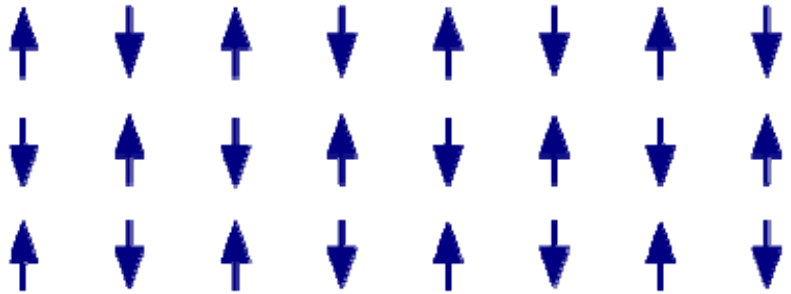
Figure4: SK2-2-12 Tubular resistance furnace and Intelligent Thermostat

Figure5: one of our sample

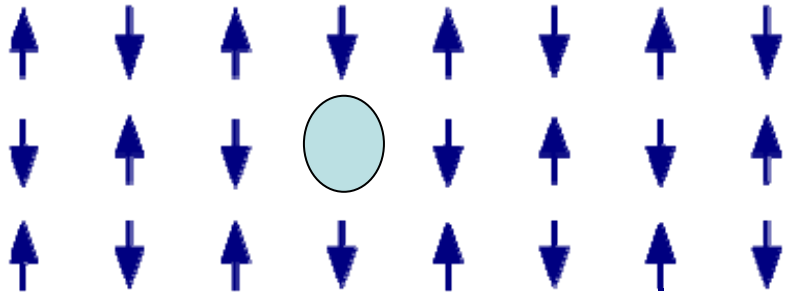
Standard sample: A	up
Our sample: B	up
Sample with step 2 twice: C	down

Experiment: resistance measurement

At room temperature (about 30^0C): $R_B > R_A > R_C$



Antiferromagnetic insulator



Doping a hole, then electrons can hopping to the site which the hole occupied

Experiment: transition temperature measurement

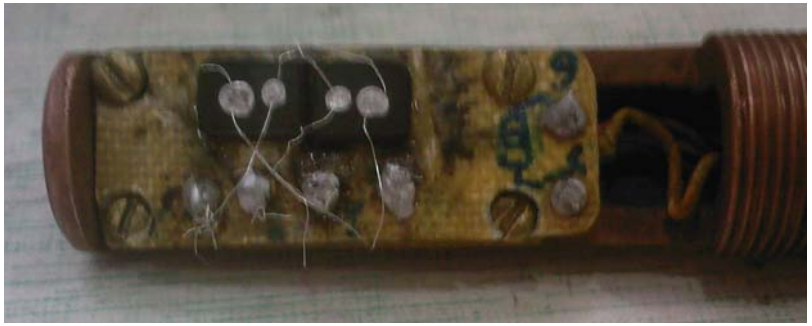
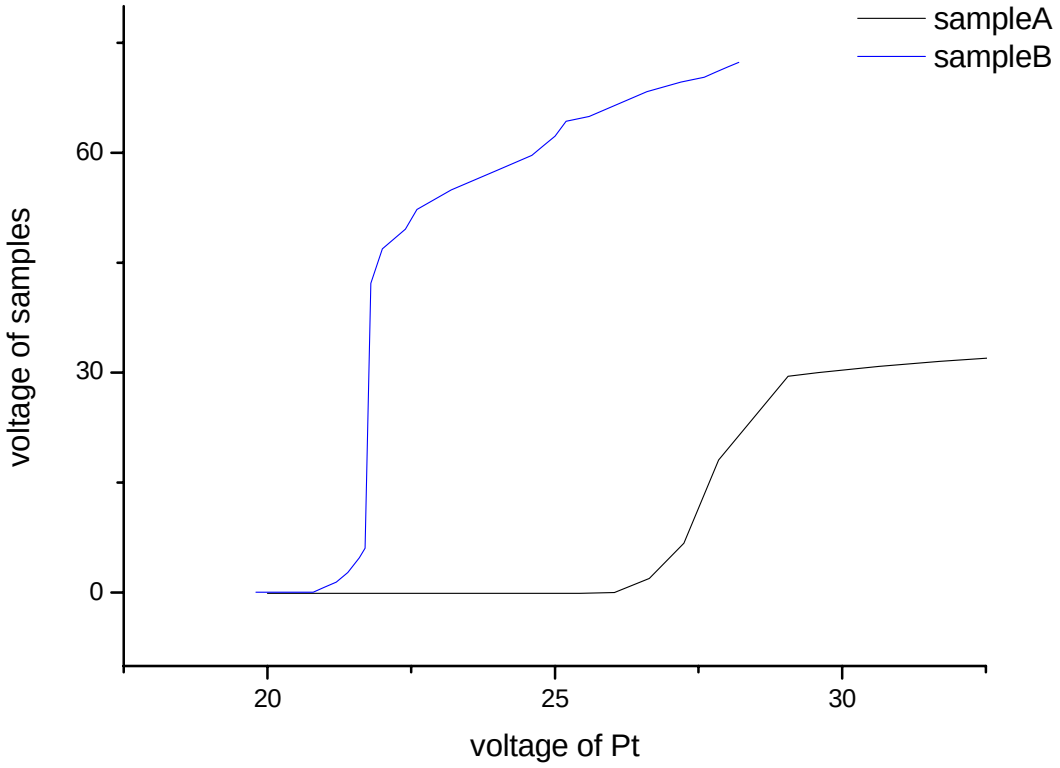


Figure6: welding sample on device

Figure7: X-Y recorder

Figure8: measurement

Experiment: transition temperature measurement



Tc_A=95K
Tc_B=82K

$Tc_A > Tc_B$

Figure9: resistance of sample A and B changing with temperature

Experiment: transition temperature measurement

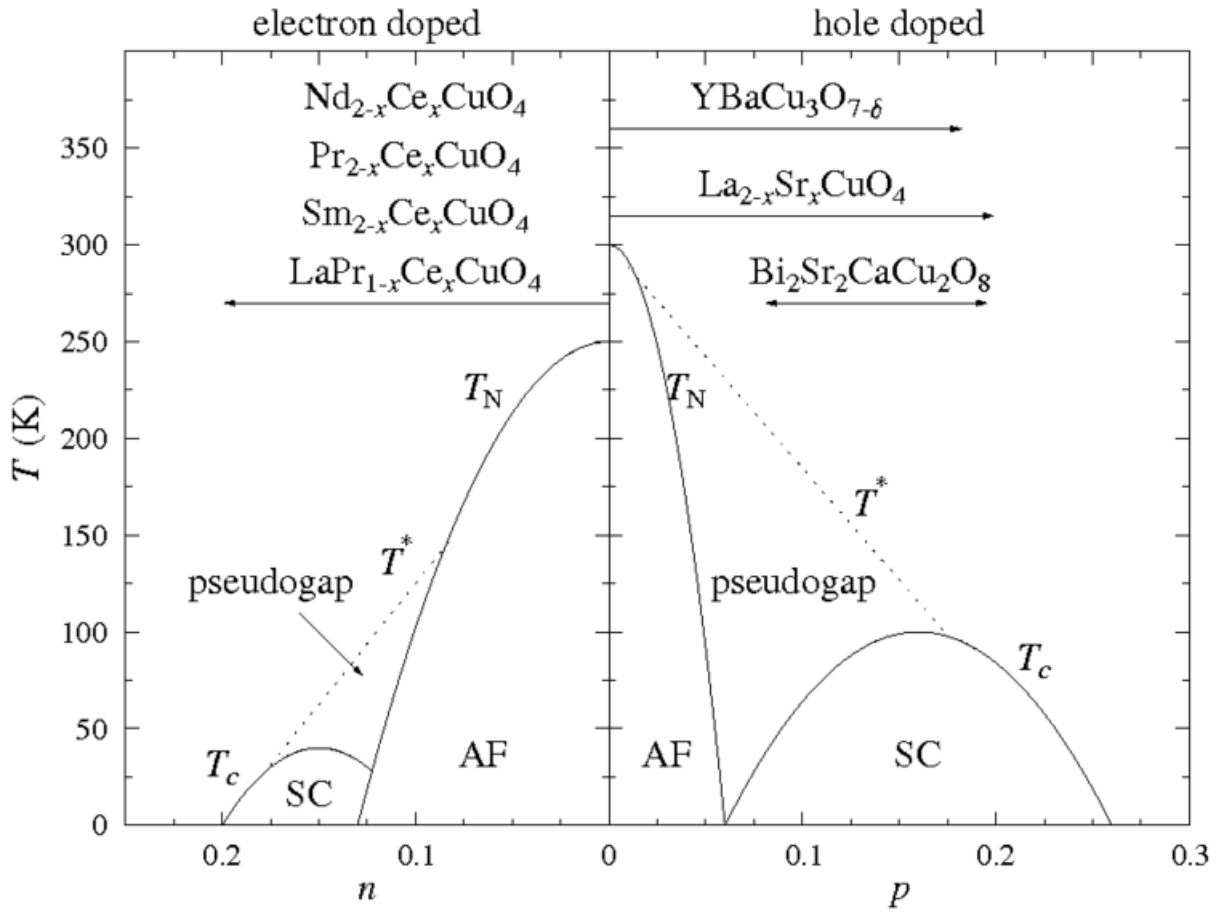


Figure10 : phase diagram of YBCO

Optimal doping level of YBa2Cu3O6+x :

X ≈ 0.93

The highest Tc is:

Tc = 92 K

M.K.Wu, C.W.Chu *et* al

Experiment: resistance character of sample A & C

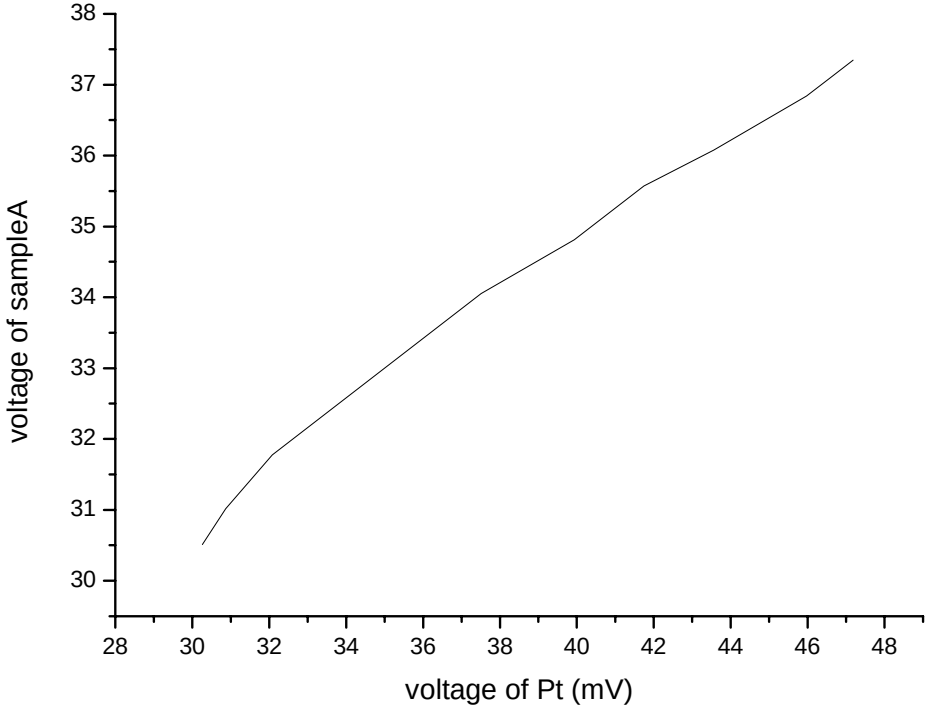


Figure 11: resistance changing with temperature of sample A

Metal?

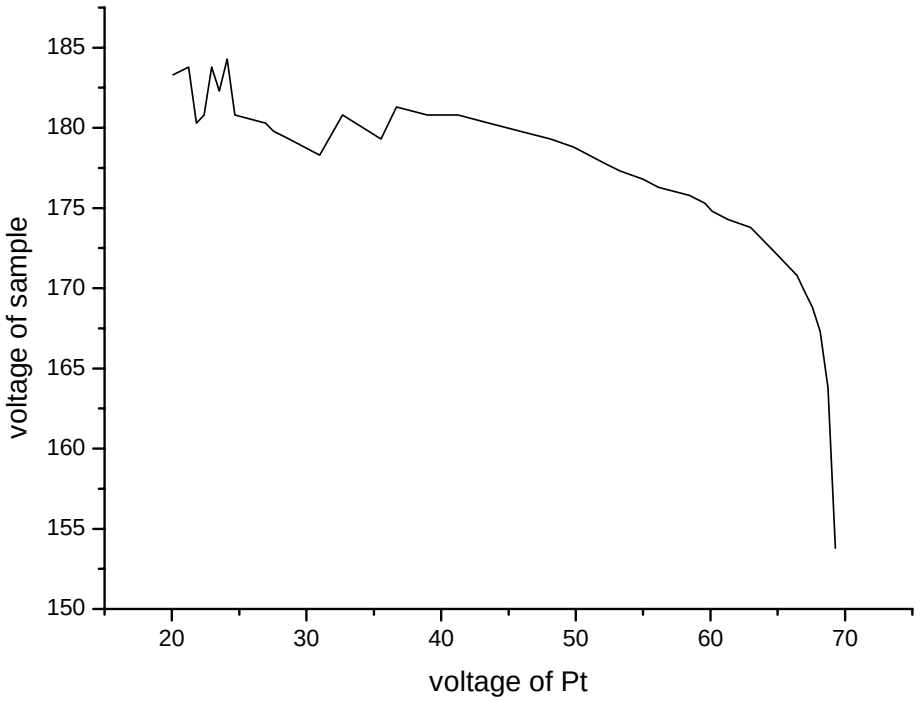
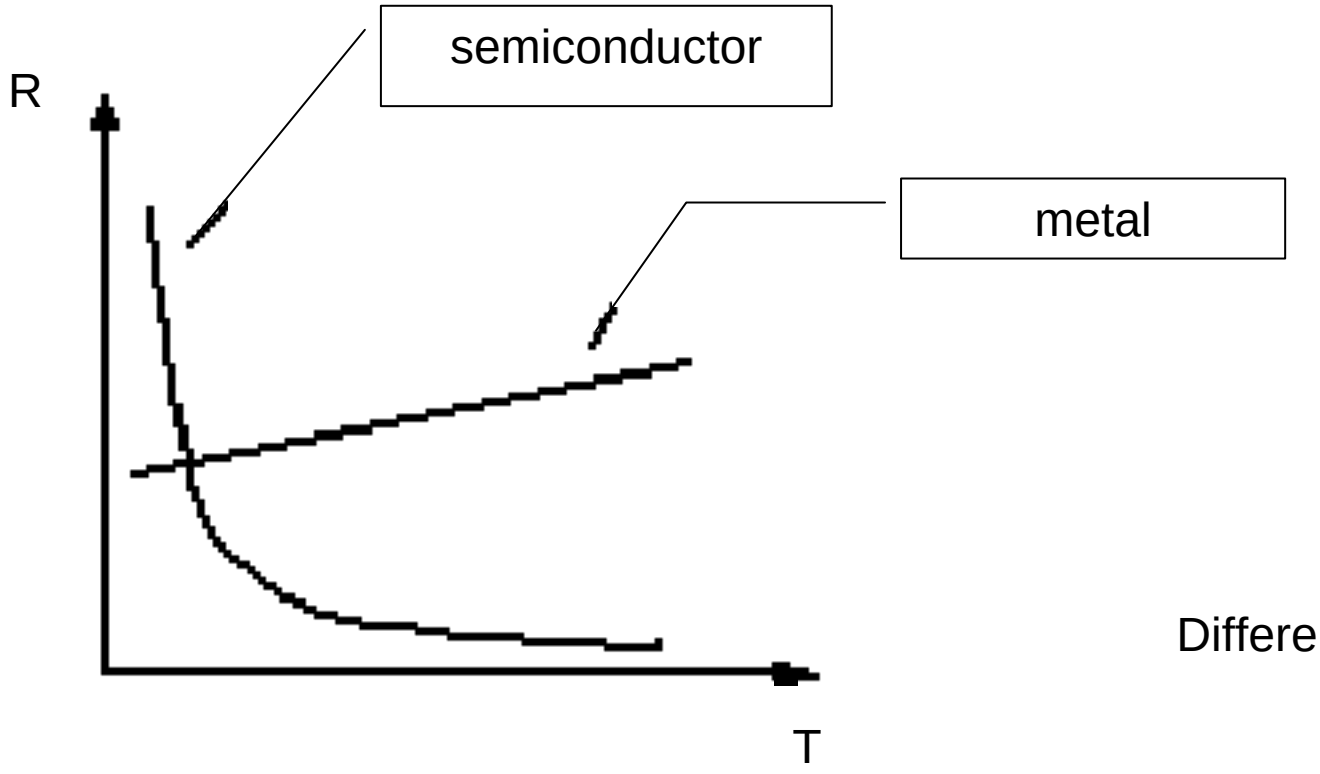


Figure 12: resistance changing with temperature of sample C

Semiconductor?

Compare with metal and semiconductor



Different !

Conclusion:

With the change of oxygen concentration x, the character of YBCO would change dramatically. From 0 to 1, the sc phase appear and disappear , also in the normal state, the electrical property is changing with x.

More work need to do about cuprate !

Acknowledgment:

Lab ,devices and base of the experiment are supported by Hong-Ying Yao.

Suggestion of Mr Xu about how to clean the mold and also how to use it.

H.M. especially thanks Y.C. for theory assistance.

Thanks!