The Study of HTS Conduction Processes in Pure & Doped Y_{123} Superconductors

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An attempt to enhance the HTS conduction due to doping has been made in Y_{123}. An attempt of resistivity transition in HTS under magnetic field is under trial. Pr – doping in HTS Y_{123} emerges effective in shifting the superconducting transition temperature in different stages.

Keywords: High Temperature Superconductors (HTS), Doping, Superconductivity.

1. INTRODUCTION

The normal state in HTS above T_c is not metallic like conventional superconductors but a mysterious pseudo gap phase. The superconducting operation is believed to have dx^2-y^2 symmetry and the characteristic distance scales (inter atomic distance a_0 = 0.3nm, Fermi wavelength λ_F = 1nm and superconducting coherence length ξ = 1.5nm) are all equivalent to each other [1,2]. Here the doping process is adopted to influence these parameters in the want of on appropriate switching of T_c [3].

2. SYNTHESIS & PREPARATION

The ingredients Y_2O_3, $BaCO_3$, CuO and Pr_6O_{11} had been taken in appropriate ratio [4]. The powedor mixture was thoroughly ground and heated at 850^0C, 875^0C, 900^0C and 925^0C with intermediate grinding. Then powder mixture palletized at 4.5 tons (K bar) pressure to form cylindrical pellets. Then pellets again reacted at 930^0C, 750^0C, 600^0C and 400^0C for 24 hours each with continuously flowing O_2. Then furnace off and cool to room temperature [5,6].

The superconducting transition was observed using the standard four-probe resistance technique at the measurement current of 5mA in the temperature range 70K to 300K [7]. Air drying silver paste was used for making electrical contacts on the samples. The sample temperature was monitored within an accuracy of ±0.1K using a standard 100-Ohm platinum sensor in conjuction with the Keithley 224 programmable constant current source and Keithley 181 Nanovoltmeter.

3. EXPERIMENTAL STUDY

The voltage V, Resistance R and the specific resistivity measurements were made at low temperature T using NPL conventional methods for pure and 10% Pr doped Y_{123} [8].

HTS and the low T behaviors of these parameters of pure Y_{123} are as depicted in Figures 1-3 and similarly HTS and the low T behaviors of these parameters of 10% Pr doped Y_{123} are as depicted in Figures 4-6.

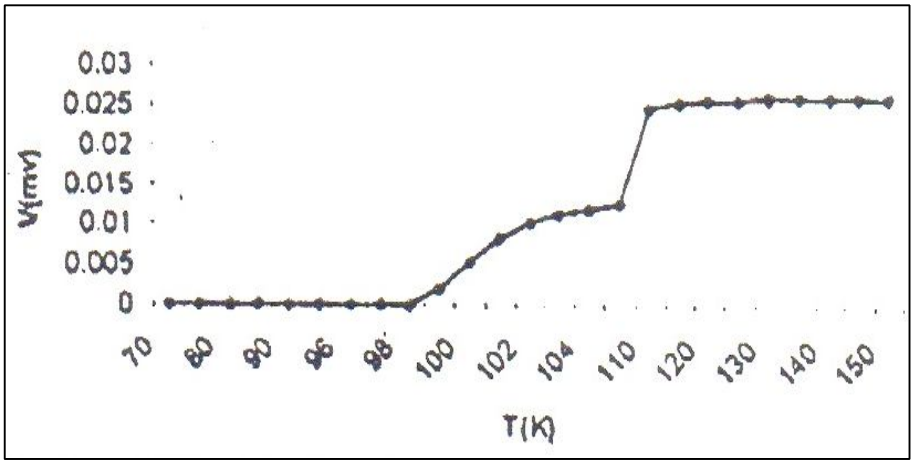

Fig. 1 : Temperature Vs Voltage for pure Y_{123}.

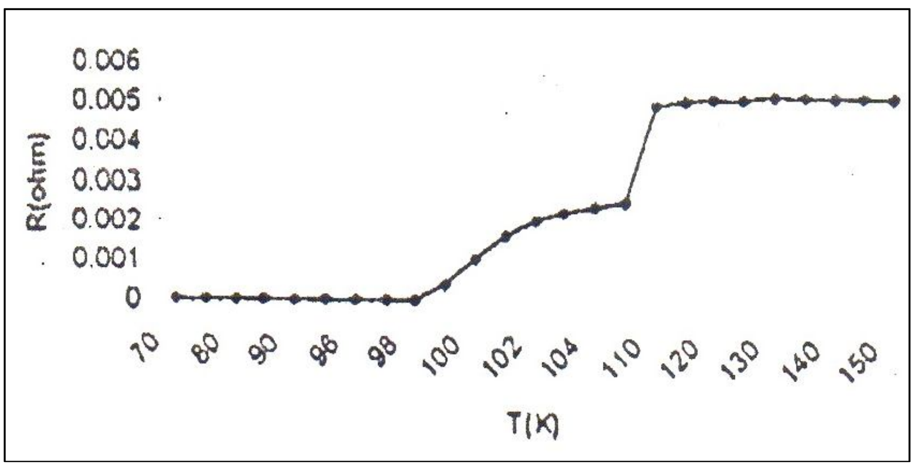

Fig. 2 : Temperature Vs Resistance for pure Y_{123}.

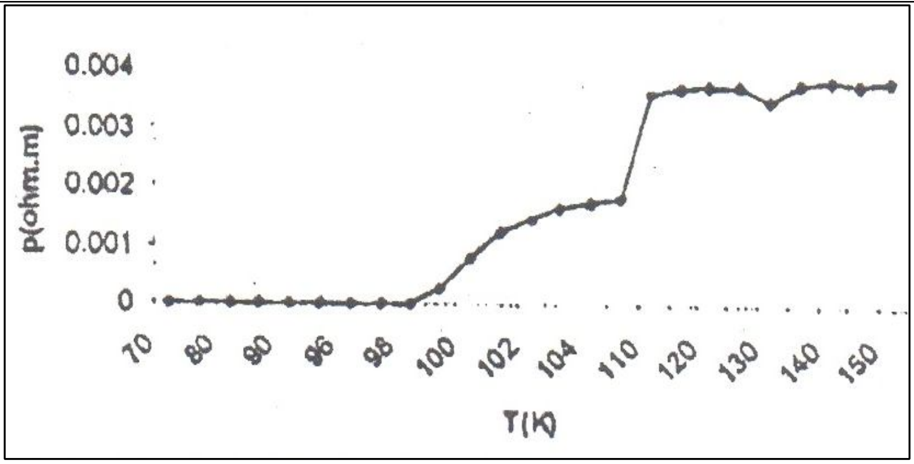

Fig. 3 : Temperature Vs Specific Resistance for pure Y_{123}.

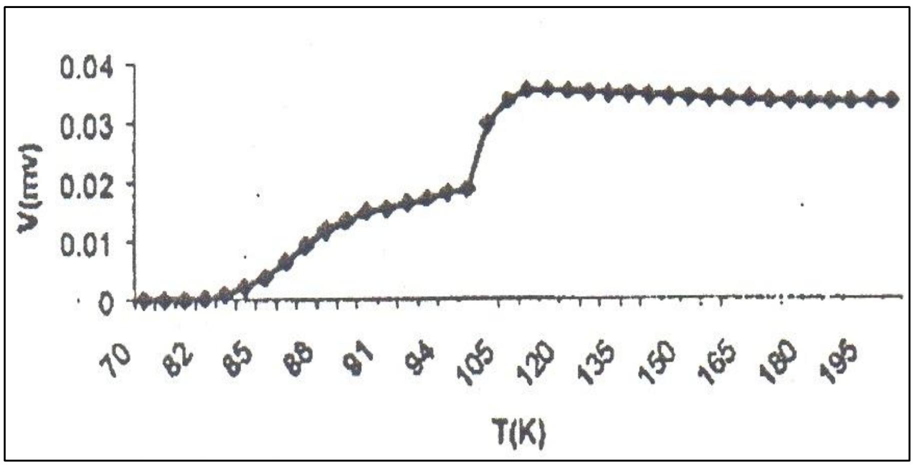

Fig. 4 : Temperature Vs Voltage for 10% Pr doped Y_{123}.

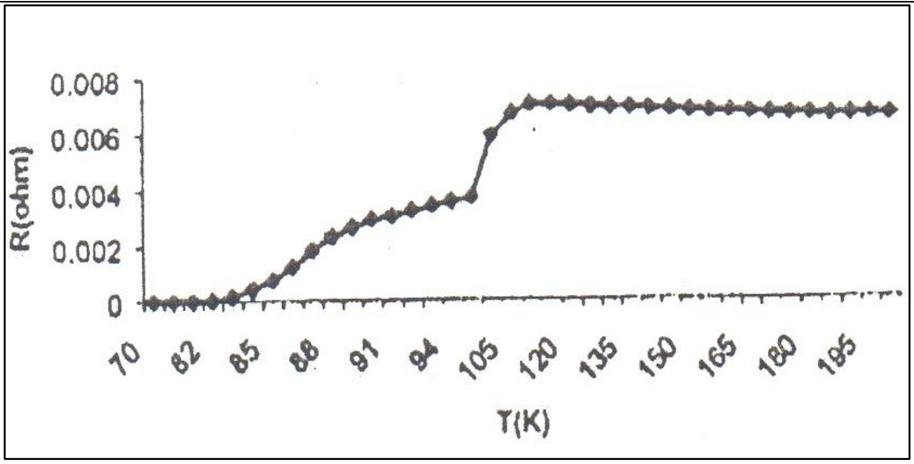

Fig. 5 : Temperature Vs Resistance for 10% Pr doped Y_{123}.

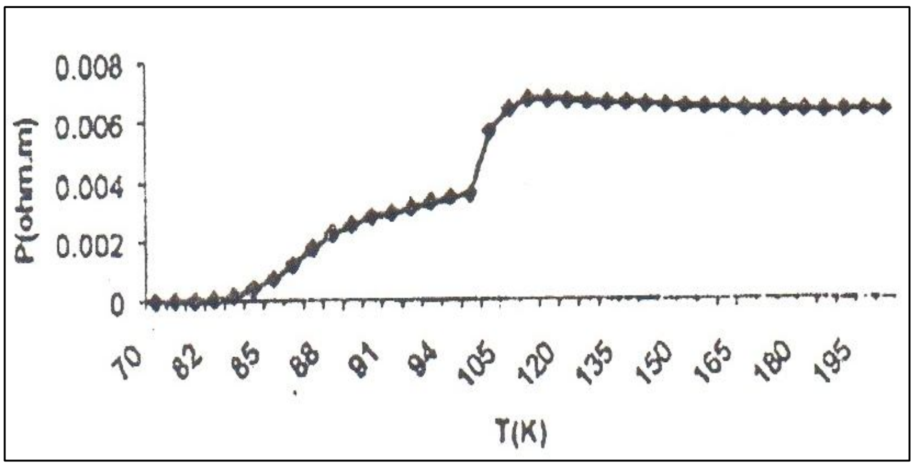

Fig. 6 : Temperature Vs Specific Resistance for 10% Pr doped Y_{123}.

4. RESULTS, DISCUSSION & CONCLUSION

There exist multi-stage transitions in pure as well as doped Y_{123} in both are sharply observable. In Pure first stage (110-115)K and superconducting 90K but for 10% Pr doped first order phase transition near 105 K and second superconducting state just near 74K. Shift $\Delta t \sim 16K$ is due to doping is achieved. Optimum dozing of doped material for desired HTS activity may be computed by simulation i.e. doping as simplest way to achieve HTS activity.

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