Growth of single crystals of a high temperature superconductor YBa2Cu3O6+x

Manju P1, Neeraj K. Rajak1, A Yogi2, A. Thamizhavel3, D. Jaiswal Nagar1

1School Of Physics, IISER Thiruvananthapuram., Thiruvananthapuram, India, 2Department of Physics, Institute for Basic Science (IBS), Seoul, Korea, Rep., 3DCMPMS, Tata Institute of Fundamental Research, Mumbai, India

E-mail: manju@iisertvm.ac.in

Quarter of a century has been crossed since the discovery of High Tc superconductivity in copper oxides, but mechanism behind this has yet to be clarified. Illuminating the electronic phase diagram of high Tc cuprates is a vital experimental step towards unravelling the mechanism behind the high Tc superconductivity phenomenon.

Increase in carrier concentration will enhance the superconductivity in the under doped regime whereas it suppress the superconductivity in over doped regime with an increase of carrier concentration [1]. Anomalous splitting in the superconducting dome [2] and the origin of mysterious pseudo gap [3] are some among the challenging features that make electronic phase diagram the most puzzling topic for the researchers.

Anisotropy is the tool to probe the inherent properties of any system experimentally, so synthesizing a high quality single crystal which is free of all kinds of defects is very important. Our report illustrates the first time synthesizing of single crystals of YBa2Cu3O6+x grown in alumina crucible whose crystal quality is in par with those grown in barium zirconate crucible. It has been found that the vertical temperature gradient has a pronounced effect on the superconducting properties of the grown single crystals: high Tc of ~ 85 K are obtained in the crystals obtained in higher temperature gradient while those grown in a lower temperature gradient have a low Tc ~ 50 K. The oxygen and subsequent homogenization annealing was done carefully to enhance the Tc to 92K with a narrow transition width. The single crystal xrd structural refinement on as-grown crystal gives a least final residual (Rf) value of 0.0239.


Keywords: Single crystal growth of YBCO, electronic phase diagram, under doped and over doped