Crystal Growth and Scattering Studies of the High T_c Superconductor $La_{2-x}Ba_xCuO_4$

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Abstract

The interplay between superconductivity, magnetism and crystal structure is a central issue in the study of the high T_c cuprates. The transition metal compound $La_{2-x}Ba_xCuO_4$ (LBCO) was the very first high T_c superconductor to be discovered, by J. G. Bednorz and K. A. Müller in 1986. However, it has been much less extensively studied due to the difficulty of growing large single crystals. We have successfully grown high quality, large LBCO crystals (with x$\sim$0.095, 0.08) using travelling solvent floating zone techniques. High resolution X-ray studies mapped out a series of tetragonal and orthorhombic structural transitions with temperature.

We have also performed neutron scattering studies at Chalk River Laboratories. We observed elastic incommensurate magnetic Bragg peaks in both samples. The elastic neutron scattering results indicate that static magnetic "stripe" ordering develops below its low temperature structural phase transition and this order persists into the superconducting state. In addition, inelastic neutron scattering measurements on the x=0.095 sample allowed us to explore the material's low energy spin excitations. The dynamic spin susceptibility remains constant within the superconducting state and decreases as the temperature rises above T_c.