ELASTIC CONSTANTS OF UNTWINNED Y$_1$Ba$_2$Cu$_3$O$_x$ SINGLE CRYSTALS

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Introduction

All nine elastic constants of a YBaCuO single crystal were determined previously using RUS (Resonant Ultrasound spectroscopy) at room temperature [1]. The aim of the present investigation was to measure the field and temperature dependence of the elastic constants using the RUS method. Sound velocity data are closely related to thermal expansion and specific heat data through thermodynamic relationships and will provide important complimentary information to previously published thermal expansion studies of YBaCuO [2].

Experimental

Single crystals grown at ISTEC were mechanically polished in order to obtain plane and parallel faces. The largest crystal had dimensions of 3 x 3 x 1 mm$^3$. The quality of the crystals was checked with a room temperature RUS setup, and then the best crystals were examined between 4 K and 300 K in zero magnetic field.

Results and Discussion

The resonant-frequency spectrum at room temperature exhibited up to 44 fairly sharp resonances, and a convergence of the fitting procedure to obtain all elastic constants appeared promising. A lot of time was spent trying to sort out the details of the elastic tensor in order to microscopically connect to the changes in elastic tensor. Unfortunately, no usable fit could be obtained in the end. This could be because the orientation is off, the sample is microcracked internally, or there are some remaining twin boundaries. Clear anomalies were seen at $T_c$ in many of the resonant frequencies, however without a usable fit, no clear connection to physics could be obtained. In the end the measurements unfortunately had to be aborted.

Conclusions

An attempt to determine the temperature and field dependence of the elastic constants in untwinned YBaCuO single crystals failed due to some unknown defects of the samples. Effort is being undertaken in order to obtain better samples for future investigations.

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References