Fabrication of Bulk Nb3Sn for use in Small Angle Neutron Scattering (SANS) to Investigate Flux Line Lattice

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Introduction

The University of Birmingham has recently asked for help in a study that aims to investigate the flux line lattice in Nb_3Sn. Nb_3Sn is a very widely used superconductor, but there are still questions about its fundamental properties. In particular, stoichiometric samples of Nb_3Sn tend to undergo a structural transition from cubic to tetragonal above T_c. The expectation is that lattice distortion and superconductivity compete with one another, however, this assertion needs to be investigated more deeply. Forgan and Blackburn of the University of Birmingham asked for 4 samples of Nb_3Sn of varying properties to aid in their investigation of coupling between the crystal symmetry and the geometry of the flux line lattice using using Small Angle Neutron Scattering (SANS) to be carried out at the Institut Laue-Langevin.

Experimental

To aid in this investigation, we have 4 polycrystalline samples of Nb_3Sn, heat treated via hot isostatic press using the same method used earlier [1]. Two of the four samples were mixed with a nominal 25 at% Sn composition and the other two with 27 at% Sn. One sample of each composition was heat treated to stay cubic at low temperatures by reducing the A15 phase Sn composition, while the other two were heat treated at lower temperature so as to maintain stoichiometry and experience the cubic to tetragonal transition above T_c. The suppression of this transition allows for superconductivity to still occur in the cubic structure, making it possible to observe the competition between lattice distortion and superconductivity in the sample using SANS (small angle neutron scattering) to see the flux line lattice of the samples.

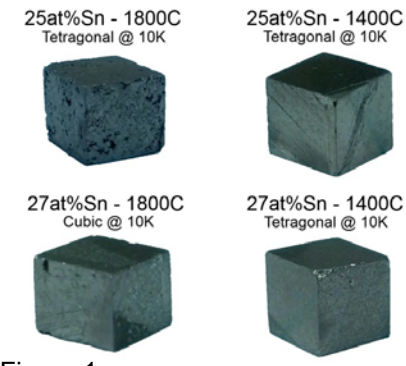

Figure 1

Results and Discussion

The T_c of all samples was determined using a SQUID (scanning quantum interference device) as can be seen in Figure 3, while low temperature XRD measurements confirmed the structures to be either cubic or tetragonal at low temperature. As can be seen in Figure 2, only 1 sample was cubic at 10 K, however, it can be observed that the transition is occurring by the splitting of the peaks around a 2θ value of 71˚.

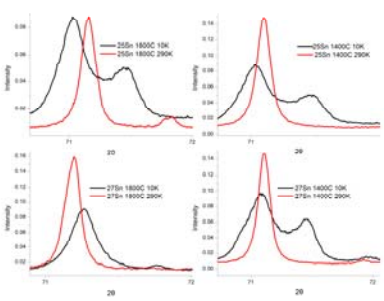

Figure 2

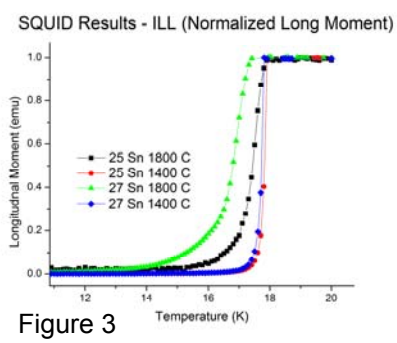

Figure 3

Conclusions

Bulk samples of Nb_3Sn were successfully created for this collaboration. We are currently awaiting results from the University of Birmingham.

Acknowledgements

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References

[1] J. Zhou et al., Appl. Phys. Lett. 99, 125507 (2011).