


Experiment title:

Negative thermal expansion in the new superconducting
Sc doped MgB_2

Experiment
number:

HS-2729

Beamline:

ID31

Date of experiment:

from: 18- April-2005 to: 22-April-2005

Date of report:

1-August-2006

Shifts:

9

Local contact(s):

Michela BRUNELLI

Received at ESRF:
Names and affiliations of applicants (* indicates experimentalists):

***Stefano AGRESTINI**, Antonio BIANCONI, Matteo FILIPPI, ***Valerio PALMISANO**

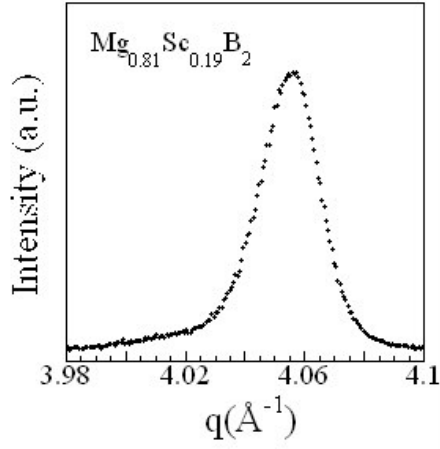
Unità INFM and Dipartimento di Fisica, Università La Sapienza, Piazzale Aldo Moro 2,
00185, Roma (Italy)

Report:

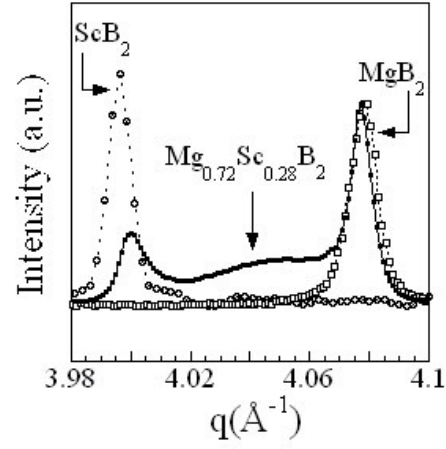
We have performed measurements by high resolution powder X-ray diffraction on the ternary system $\text{Mg}_{1-x}\text{Sc}_x^{10}\text{B}_2$. The samples of $\text{Mg}_{1-x}\text{Sc}_x^{10}\text{B}_2$ used for the experiments were synthesized by a direct reaction method of elemental magnesium, scandium and boron enclosed in a stoichiometry ratio in tantalum crucibles, sealed by arc welding under argon atmosphere and were well characterized for their superconducting and phonon properties by resistivity and Raman spectroscopy measurements respectively.

Initially we have characterized the samples at room temperature (Figure 1). High resolution X-ray diffraction have indicated a phase separations for $x > 0.27$ into a Sc-poor and a Sc-rich phase (Figure 1b). The phase separated samples exhibit a critical temperature slightly higher than the pristine Mg^{10}B_2 .

We have studied the thermal expansion of the pure Mg^{10}B_2 . The measurements were made at 26 different temperatures in the range between 5 K and 300 K. The first analysis of the data suggest that the *a*-axis shows a small negative thermal expansion below $T^* = 60$ K, while the *c*-axis shows an upturn in corrispondance of T_c with decreasing the temperature.



a)



b)

Figure 1: (002) reflection of high resolution x-ray diffraction of the samples $\text{Mg}_{1-x}\text{Sc}_x^{10}\text{B}_2$ for $x=0.19$ on the left (a) and $x=0.28$ on the right (b).

During the allocated beamtime we found a gradient of Sc content in our doped samples. This unexpected gradient has prevented in performing the planned study on thermal expansion as a function of Sc content in the $\text{Mg}_{1-x}\text{Sc}_x^{10}\text{B}_2$ system.

Therefore to optimize the allocated beamtime we have focused our attention on the thermal expansion in the $\text{Mg}_{1-x}\text{Al}_x^{10}\text{B}_2$ system. In particular we have studied the thermal expansion for the $\text{Mg}_{0.70}\text{Al}_{0.30}^{10}\text{B}_2$ system at 21 different temperatures in the range between 5 K and 300 K. Although the data are scattered and still under analysis, anomalies appears in the thermal expansion of the a - and c -axis with the a -axis showing a small negative thermal expansion below $T^*=60$ K.