Report

High-pressure X-ray investigation of phase transitions in model quantum spin system SrCu2(B03)2
Experimental report

Author(s):
Zayed, Mohamed; Rüegg, Christian; Rønnow, H.M.

Publication Date:
2014

Permanent Link:
https://doi.org/10.3929/ethz-a-010243257

Rights / License:
In Copyright - Non-Commercial Use Permitted
Experiment title:
High-pressure X-ray investigation of phase transitions in model quantum spin system SrCu2(BO3)2

Experiment number:
HS-3692

Beamline: ID9A
Date of experiment: from: 18 February 2009 to: 24 February 2009

Date of report:

Shifts: 18
Local contact(s):
M. Hanfland, M. Merlini

Names and affiliations of applicants (* indicates experimentalists):
M. E. Zayed*
Laboratory for Neutron Scattering, Paul Scherrer Institute, 5232 Villigen PSI, Switzerland
Laboratory for Quantum Magnetism, Ecole Polytechnique Fédérale de Lausanne (EPFL), 1015 Lausanne, Switzerland

Ch. Rüeegg*
Laboratory for Neutron Scattering, Paul Scherrer Institute, 5232 Villigen PSI, Switzerland

H. M. Rønnow*
Laboratory for Quantum Magnetism, Ecole Polytechnique Fédérale de Lausanne (EPFL), 1015 Lausanne, Switzerland

Report:

We performed synchrotron X-ray single crystal and powder diffraction measurements as a function of pressure and temperature in order to determine the structural phase diagram of the Shastry-Sutherland quantum magnet SrCu2(BO3)2.

Hydrostatic pressure ranging from ambient to 19 GPa was applied to the samples by mean of a diamond anvil cell (DAC), with helium as pressure transmitting medium. Pressure calibration was performed using the ruby luminescence method. Temperature was varied from ambient to 25 K using a helium cooled cryostat. The single crystal samples (~30 x 30 x 5 μm³) were placed in the DAC with c-axis parallel to the X-ray beam and rotated by ± 10° during exposure while the powder samples were rotated by ± 3°.

We could observe the distortion from the ambient tetragonal to the monoclinic phase [1] and follow this transition as a function of temperature down to 30 K. The transition essentially remained confined in the 4 – 5 GPa range [2]. A higher pressure first order transition around 15 GPa was also observed.

A full refinement of the powder diffraction data was not possible due to the presence of impurities in the sample.

Figure 1 shows a typical peak splitting observed on ID9A with SrCu2(BO3)2 in the DAC for both a powder and a single crystal sample.
Figure 1: Pressure dependence of Bragg reflections in SrCu$_2$(BO$_3$)$_2$. (a) Powder sample, T=202 K. The (2,1,1) tetragonal reflection splits into several non equivalent monoclinic reflections. (b) Single crystal. The original (5,1,0) tetragonal reflection abruptly changes position above 4.59 GPa. Above this pressure, the reflection broadens and can be fully resolved as two non-equivalent peaks around 8 GPa. Peaks are shifted vertically for clarity.

References:
