

**Experiment title:**

Magnetic and electronic phase transitions in the multiferroic $R\text{Fe}_3(\text{BO}_3)_4$ ($R = \text{Nd}, \text{Gd}, \text{Ho}$) crystals at the high pressures and low temperatures

Experiment number:

HC-4507

Beamline:

ID-18

Date of experiment:

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Shifts:

9

Local contact(s):

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Report:

The goal of the project was to study the magnetic and electronic phase transitions in the $\text{GdFe}_3(\text{BO}_3)_4$ single crystals induced by high-pressures and cryogenic temperatures by the Synchrotron Mössbauer Spectrometry (SMS) on the Fe-57 nuclei.

We have successfully collected sets of SMS spectra of the $\text{GdFe}_3(\text{BO}_3)_4$ Fe-57 isotope enriched single crystal in the Diamon Anvil Cell (DAC) under pressure till to 73 GPa in the temperature range 2.5 – 295 K. All the data were obtained in the ESRF membrane DAC.

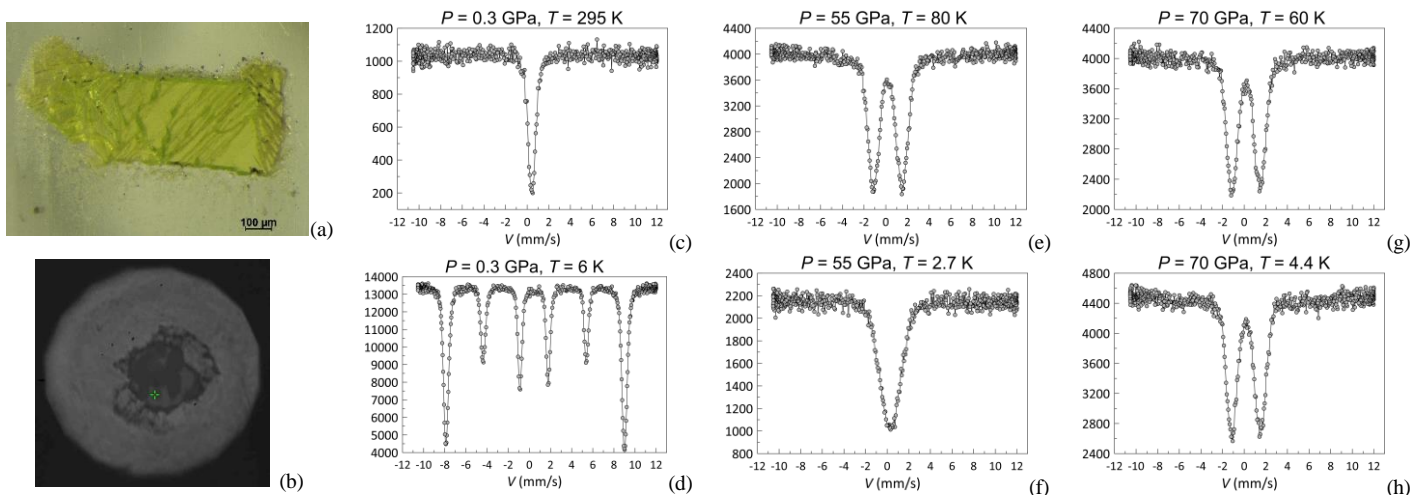


Figure 1. (a) – original $\text{Gd}^{57}\text{Fe}_3(\text{BO}_3)_4$ single crystal; (b) – small part of original $\text{Gd}^{57}\text{Fe}_3(\text{BO}_3)_4$ single crystal in the DAC at $P = 0.3$ GPa; (c) – (h) – synchrotron Mössbauer spectra of the $\text{Gd}^{57}\text{Fe}_3(\text{BO}_3)_4$ single crystal in the DAC at some pressures and temperatures.

A preliminary analysis of the experimental data obtained confirmed the existence of two phase transitions at pressures of about 30 GPa and 50 GPa, with a change in the state of iron Fe^{3+} ions from high-spin to low-spin and complete suppression of magnetic ordering at pressures above 50 GPa. A complete data analysis is in progress. The quality and volume of the collected data seems to be sufficient to reach the scientific goals of proposal but only for the $\text{GdFe}_3(\text{BO}_3)_4$ Fe-57 enriched compound. It seems necessary to continue the high pressure SMS measurements for $\text{NdFe}_3(\text{BO}_3)_4$ and $\text{HoFe}_3(\text{BO}_3)_4$ single crystals Fe-57 isotope enriched.