Experimental report

27/12/2022

Proposal: CRG-2770 **Council:** 4/2020

Title: Study of the competition between magnetism and superconductivity in BaFe2Se3

Research area:

This proposal is a new proposal

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Samples: BaFe2Se3

Instrument	Requested days	Allocated days	From	To
D1B	2	2	10/02/2021	12/02/2021

Abstract:

Study of the competition between magnetism and superconductivity in $BaFe_2Se_3$

- Objective & expected results : -

The main aim of this proposal was to perform powder neutron diffraction experiments on $BaFe_2Se_3$ at high pressure and low temperature. The existence of magnetic order in the superconducting phase of $BaFe_2Se_3$ could be verified. Besides, the magnetic structural transition with pressure will be studied.

- Results and the conclusions of the study (main part): **-**

Recently, the Iron-based spin ladder $BaFe_2Se_3$ has attracted much attention due to its superconductivity under pressure. Besides, $BaFe_2Se_3$ displays an exotic block-like magnetic state which is unique in its family. Unconventional superconductivity and magnetism seem to be mutually exclusive in most cases. Since the superconductivity in $BaFe_2Se_3$ emerges above 10 GPa, it is necessary to study its magnetic evolution with the increasing of pressure.

In this proposal, we used powder neutron diffraction (PND) to investigate the magnetic structures of $BaFe_2Se_3$ at different pressures. Figure 1(a) shows the PND patterns of $BaFe_2Se_3$ at different pressures. As we can see, the (0.5 0.5 0.5) magnetic peak disappeared at 4.2 GPa while the (0.5 1 0.5) magnetic peak emerged. This indicates a magnetic transition from block-type to a stripe-type. The refinement of the pattern at 4.2 GPa is shown in Figure 1(b). The CX magnetic order is well fitted with the collected pattern. On the other hand, no obvious magnetic peak was observed at 11.7 GPa which is in the superconducting phase. This indicates that the magnetic order is suppressed by the superconductivity.

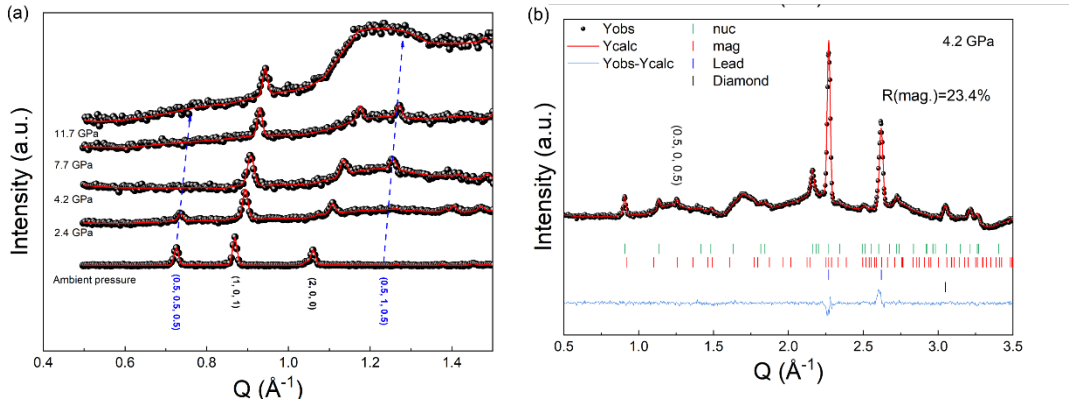

Figure1: (a) Powder neutron diffraction patterns of $BaFe_2Se_3$ at 3 K under different pressure. (b) PND pattern refinement of $BaFe_2Se_3$ at 3 K under 4.2 GPa. The red line indicates the fitted curve with CX magnetic order.