Experimental report

04/04/2016

Proposal: 4-01-1228 **Council:** 4/2012

Title: Magnetic excitation spectrum of layered selenide AgCrSe2

Research area: Physics

This proposal is a new proposal

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Samples: AgCrSe2

Instrument	Requested days	Allocated days	From	To
IN5	4	0		
IN4	6	5	26/10/2012	31/10/2012

Abstract:

Layered chalcogenide AgCrSe2 is a parent compound of multiferroic AgCrS2. Although AgCrS2 exhibits a collinear stripe-like antiferromagnetic spin order below TN, the magnetic structure of AgCrSe2 is reported to be helicoidal, with an (ab) plane magnetic anisotropy. Our aim is to carry on an investigation of AgCrSe2 using powder inelastic neutron scattering, so as to determine the spin excitations spectrum, and understand the differences between the magnetic exchange paths and values that can stabilize such different magnetic configurations in structurally closely related compounds.

Experimental reports on Exp. 4-01-1228 at IN4

The results of this experiment on IN4 have been published in Scientific Retports (Scientific Reports | 6:23415 | DOI: 10.1038/srep23415):

Localised Ag^+ vibrations at the origin of ultralow thermal conductivity in layered thermoelectric $AgCrSe_2$

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In materials science, the substructure approach consists in imagining complex materials in which a particular property is associated with a distinct structural feature, so as to combine different chosen physical characteristics, which otherwise have little chance to coexist. Applied to thermoelectric materials, it has been used to achieve simultaneously phonon-glass and electron-crystal properties. Mostly studied for its superionic conductivity, $AgCrSe_2$ is a naturally layered compound, which achieves very low thermal conductivity, ~0.4 W.K−1.m−1 at RT (room temperature), and is considered a promising thermoelectric. The Cr atoms of the $[CrSe_2]_\infty$ layer bear a spin S = 3/2, which orders below TN = 55 K. Here we report low temperature inelastic neutron scattering experiments on $AgCrSe_2$, alongside the magnetic field evolution of its thermal and electrical transport. We observe a very low frequency mode at 3 meV, ascribed to large anharmonic displacements of the Ag^+ ions in the $[Ag]_\infty$ layer, and 2D magnetic fluctuations up to 3 TN in the chromium layer. The low thermal conductivity of $AgCrSe_2$ is attributed to acoustic phonon scattering by a regular lattice of Ag^+ oscillating in quasi-2D potential wells. These findings highlight a new way to achieve localised phonon modes in a perfectly crystalline solid.