Contribution ID: **308** Type: **Poster Presentation**

Synthesis, characterization and magnetic ordering of the semiconducting intermetallic compound FeGa₃

Wednesday, 9 July 2014 17:10 (1h 50m)

Abstract content
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Intermetallic compounds which are formed by good conductive metals are usually metallic. However, FeGa₃ was found to be a semiconductor with a narrow gap measured to be between 0.2 and 0.46 eV [1,2,3]. This gap mainly arises from the hybridization between the Ga 4p and Fe 3d bands [4]. The band-gap has been established experimentally by various techniques [4,5], and its origin verified by density functional theory (DFT) calculations [2,5].
FeGa₃ crystallizes in the tetragonal space group P4₂/mnm (No. 136) [3]. The magnetism in this compound has not yet been observed, with various magnetization and specific heat measurements suggesting that it does not occur down to very low temperatures [4,6]. Recent work has also shown that the effect of the chemical doping on single crystal FeGa₃ creates a spin 1/2 local moment and drives the compound to become metallic [7]. Mössbauer spectroscopy (MES) has shown the absence of an internal magnetic field at the site of Fe confirming that no ordering above room temperature occurs [3]. FeGa₃ has recently been predicted to become metallic under pressure [1].
We will report on the preliminary results for this project. In particular, we will show how FeGa₃ single crystals has been synthesized by the self flux method, and then characterized by means of x-ray diffraction, energy dispersive analysis and MES. Furthermore, our measurements of the magnetic state of FeGa₃ as a function of temperature using MES will provide insights not previously reported. Our planned measurements as a function of pressure to search for a proposed metal-insulator transition will also be discussed.

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Session Classification: Poster2

Track Classification: Track A - Division for Physics of Condensed Matter and Materials