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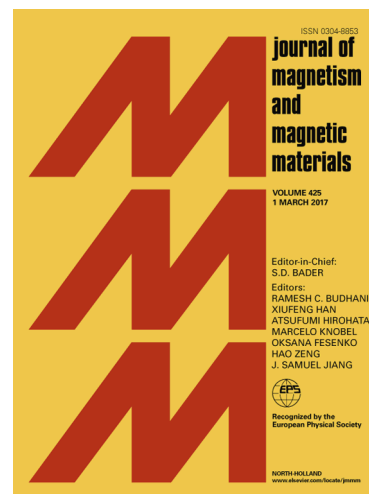
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Magnetic ordering in the nano-laminar ternary Mn_2AlB_2 using neutron and X - ray diffraction

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Abstract

The nano-laminar ceramic Mn_2AlB_2 belongs to the orthorhombic M_2AlB_2 system ($\text{M} = \text{Cr}, \text{Fe}, \text{Mn}$), in which Fe_2AlB_2 was shown to be ferromagnetic near room temperature. Herein, the magnetic state of $\text{Mn}_2\text{Al}^{11}\text{B}_2$ is investigated using magnetization, in the 5 to 360 K temperature range, X-ray diffraction in the 300 to 800 K range and neutron diffraction in the 1.6 to 300 K range. From the totality of our results we conclude that below ~ 390 K Mn_2AlB_2 becomes a canted antiferromagnet. The crystallographic unit cell is doubled along the c axis (i.e. a propagation vector of $0,0,1/2$) and the ordered Mn magnetic moments are oriented either along the a or the b axes, with a magnetic moment reaching $0.71(2) \mu_B$ per Mn atom at 1.6 K. This magnetic structure is in excellent agreement with, and contributes to the validity of the recently reported theoretical calculations for the $(\text{Fe}_{1-x}\text{Mn}_x)_2\text{AlB}_2$ system.

Keywords: antiferromagnetism; laminar structures; neutron diffraction; canting

I. Introduction

The magnetic properties of boride compounds have attracted scientific attention over the years. For example, $\text{Nd}_2\text{Fe}_{14}\text{B}$ was found [1] to simultaneously exhibit high magnetic anisotropy and ordered magnetic moment. The binary transition metal (M) borides, M_nB_m , were shown [2–4], to order magnetically at relatively high temperatures (~ 600 K). While Fe_2B was shown [3] to be ferromagnetic

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