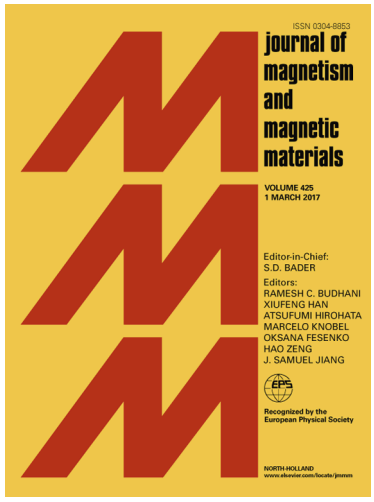

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Magnetic ordering in the nano-laminar ternary Mn_2AlB_2 using neutron and X - ray diffraction

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Abstract

The nano-laminar ceramic Mn_2AlB_2 belongs to the orthorhombic M_2AlB_2 system (M = Cr, Fe, Mn), in which Fe_2AlB_2 was shown to be ferromagnetic near room temperature. Herein, the magnetic state of $Mn_2Al^{11}B_2$ 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) μ_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 $(Fe_{1-x}Mn_x)_2AlB_2$ 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, $Nd_2Fe_{14}B$ 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