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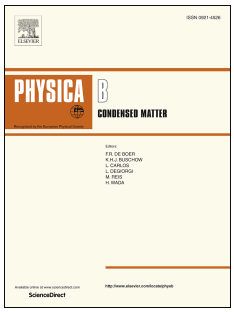

First-order magnetic transition, magnetocaloric effect and moment formation in MnFe(P,Ge) magnetocaloric materials revisited by x-ray magnetic circular dichroism

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First-order magnetic transition, magnetocaloric effect and moment formation in MnFe(P,Ge) magnetocaloric materials revisited by x-ray magnetic circular dichroism

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Abstract

Fe_2P-based materials are attracting great interest for their giant magnetocaloric effect making them highly promising candidates for a new energy efficient-magnetic cooling technology. In light of recent results reported in the MnFe(P,Si) and MnFe(P,Si,B) series, here we revisit the effect of Ge substitution for P. By fixing the Mn/Fe ratio to unity while exploring a large range of Ge content, we isolate the effect Ge plays as metalloid element. In contrast to other metalloids (like Si, B or As), Ge substitution for P is found to spectacularly increase the Curie temperature, while preserving the first-order character of the transition. As a consequence, Ge substitution for P provides a mean to achieve giant magnetocaloric performances up to high temperatures (at least 465 K). In addition, the moment formation in MnFe(P,Ge) is investigated using an element specific and orbital selective magnetization probe, x-ray magnetic circular dichroism. The magnetic moments carried by Mn atoms are found to be significantly larger than that of Fe, providing a direct experimental support to band structure calculations and neutron diffraction experiments in previous work.

1. Introduction

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