Experimental report

13/09/2019

Proposal: 7-01-441 **Council:** 4/2016

Title: Interplay between phonon and magnon excitations in the magnetocaloric Fe2P based alloys.

Research area: Physics

This proposal is a new proposal

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Samples: Fe2P
FeMnP0.5Si0.5

Instrument	Requested days	Allocated days	From	To
IN5	5	4	08/09/2016	12/09/2016
IN6	5	0		

Abstract:

A lot of experimental and theoretical attention has been paid to compounds that display magnetocaloric properties in an effort to reduce the worlds dependency on hazardous gasses such as hydrofluorocarbons for refrigeration.
Fe2P based alloys have shown great potential for magnetocaloric devices. The aim of this work is to perform a comparative study of the low energy dynamics in the parent compound, Fe2P, and the most promising compound, FeMnP0.5Si0.5, to gain a further grasp on the role of electron-phonon interactions and magnetoelastic coupling that lead to the enhanced entropy change necessary for magneto caloric devices.

Magnetocaloric effect in Fe_2P: Magnetic and phonon degrees of freedom

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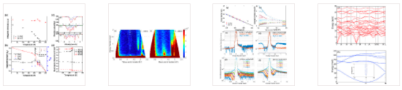
ABSTRACT

Devices based on magnetocaloric materials provide great hope for environmentally friendly and energy efficient cooling that does not rely on the use of harmful gasses. Fe_2P based compounds are alloys that have shown great potential for magnetocaloric devices. The magnetic behavior in Fe_2P is characterized by a strong magnetocaloric effect that coexists with a first-order magnetic transition (FOMT). Neutron diffraction and inelastic scattering, Mössbauer spectroscopy, and first-principles calculations have been used to determine the structural and magnetic state of Fe_2P around the FOMT. The results reveal that ferromagnetic moments in the ordered phase are perturbed at the FOMT such that the moments cant away from the principle direction within a small temperature region. The acoustic-phonon modes reveal a temperature-dependent nonzero energy gap in the magnetically ordered phase that falls to zero at the FOMT. The interplay between the FOMT and the phonon energy gap indicates hybridization between magnetic modes strongly affected by spin-orbit coupling and phonon modes leading to magnon-phonon quasiparticles that drive the magnetocaloric effect.



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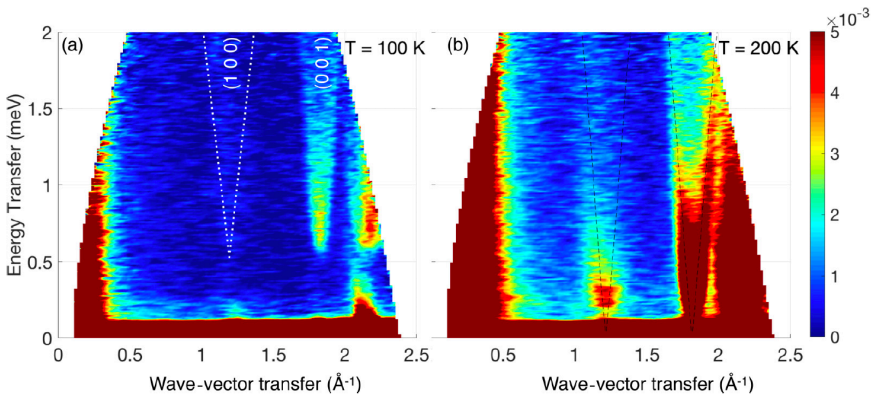

FIG. 2. S(Q, ω) (E_i = 3.27 meV) dependence at (a) 100 K, white dotted line indicates the phononic region around (1 0 0), (b) 200 K, the dashed linescorrespond to gapless phonons with E = DQ behavior (D = 12 meVÅ).