Experimental report

17/09/2018

Proposal: 5-31-2546 **Council:** 4/2017

Title: Determination of the magnetic structures of eight Yb1-xRxMn6Sn6 alloys (R = Sc or Zr with 0.1 < x < 0.9)between 320 K and 2 K.

Research area: Materials

This proposal is a new proposal

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Samples: Yb1-xRxMn6Sn6

Instrument	Requested days	Allocated days	From	To
D1B	4	4	14/06/2018	18/06/2018

Abstract:

We wish to investigate the composition and temperature dependence of the magnetic structure in two freshly stabilized related series of alloys, namely Yb1-xScxMn6Sn6 (0 < x < 1) and Yb1-xZrxMn6Sn6 (0 < x < 0.4). DC magnetization data have shown a paramagnetic-ferromagnetic transition near room temperature. At lower temperature the Mn sublattice evolves towards antiferromagnetic-like states. Powder neutron diffraction using D1B diffractometer is essential to determine magnetic structures of some representative compositions of Yb1-xRxMn6Sn6 (R = Sc or Zr). Results should precise the influence of the R valency and interatomic distances upon the Mn sublattice magnetic behavior in these alloys.

Experimental report ILL experiment 5-31-2546:

A beam time of 4 days was devoted to the study of the temperature dependence of the magnetic structures of some $Yb_{1-x}R_xMn_6Sn_6$ (R = Sc or Zr) representatives in the 2 – 320 K temperature range using the D1b diffractometer.

We recently showed a ferromagnetic to antiferromagnetic transition of Mn sublattice in $Yb_{1-x}Sc_xMn_6Sn_6$ compounds when intermediate valent Yb ($\upsilon \sim 2.6$) is replaced by trivalent Sc [1]. The results confirm a prevailing role of valence electron concentration on Mn magnetic behavior in this family of compounds. Neutron diffraction data have allowed us to determine magnetic structures, especially in the antiferromagnetic region of the magnetic phase diagram.

We investigated 4 different compositions: in each case, long duration patterns were recorded at 320 K and 2 K (figure) as well as a thermal scan between these two temperatures. For some compositions, some long duration patterns were recorded at intermediate temperatures.

As can be seen on the figure, the structure is helimagnetic and the q_{Z1} component is found to increase upon Sc substitution. We built the $Yb_{1-x}Sc_xMn_6Sn_6$ (x, T) magnetic phase diagram. It forecasts the occurrence of interesting multicritical points where several magnetic phases meet.

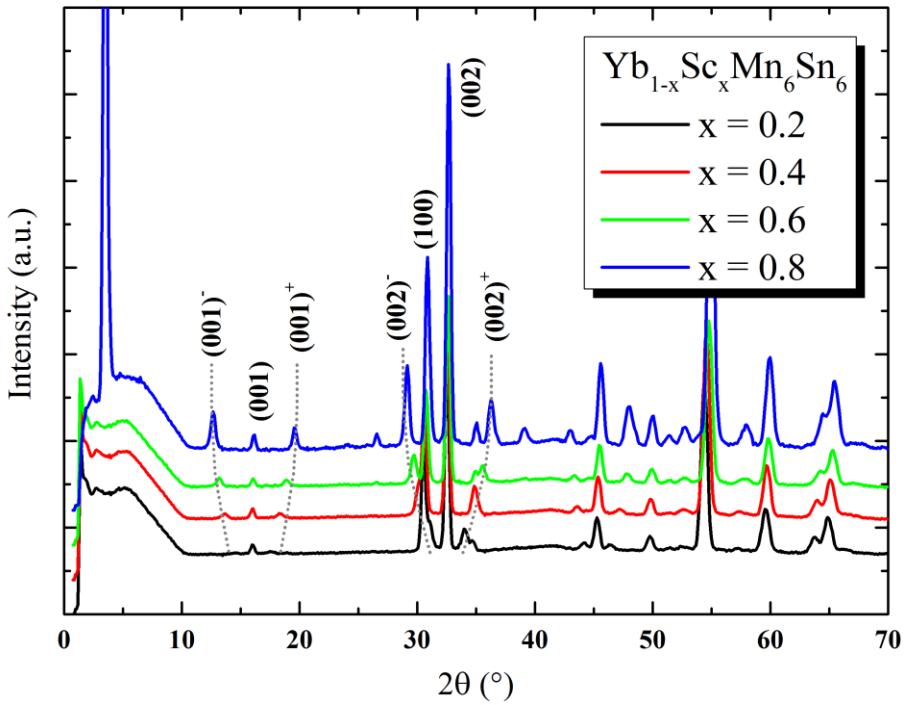

Fig. Neutron diffraction patterns of $Yb_{1-x}Sc_xMn_6Sn_6$ (x = 0.2; 0.4; 0.6; 0.8) at 2 K. Dotted lines are guides to the eye and bring out the composition dependence of the magnetic peak positions.

[1] Eichenberger L. *et al.*, submitted to JALCOM, *under review.*