XXXII Panhellenic Conference on Solid State Physics and Materials Science
Conference Center "Carolos Papoulias", 18-21 September 2016, Ioannina, Greece

Structure and magnet properties of $R_{1-x}Zr_xFe_{10}Si_2$ alloys with R = Nd, Sm

M.Gjoka[1], V. Psycharis[1], Ch. Sarafidis[2], E. Devlin[1], D. Niarchos[1] and G. Hadjipanayis[3]
[1] Institute of Nanoscience and Nanomaterials, NCSR Demokritos, Athens, Greece
[2] Department of Physics, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece
[3] Department of Physics and Astronomy, University of Delaware, Newark, De, USA

The tetragonal $R(Fe,T)_{12}$ alloys, where R is a rare earth and T is a stabilizing transition metal, are promising candidates for permanent magnet alloys due to their appropriate magnetic properties. Recently there is a resurgence of interest in the formation of the $R(Fe,T)_{12}$ structure, replacing now the rare-earth with Zr, which has produced very interesting results [1].

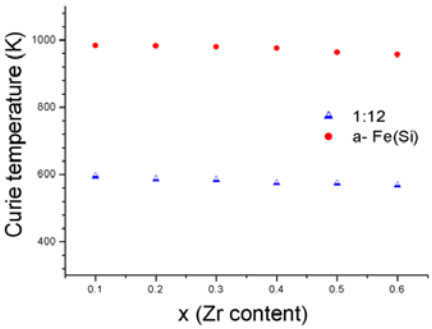

Fig.1 Dependence of Curie temperature from Zr for $Sm_{1-x}Zr_xFe_{10}Si_2$

Alloys with nominal composition $R_{1-x}Zr_xFe_{10}Si_2$, with $0.1 \leq x \leq 0.8$ (R=Sm, Nd), were prepared by arc- melting. Furthermore, rapidly solidified ribbons were prepared for the series $Sm_{1-x}Zr_xFe_{10}Si_2$ (x=0.2-0.6) using melt-spinning with wheel speeds of 15- 55 ms^{-1} and then annealed in the interval 773-1173K.

Structural and magnetic characterization of these alloys has been carried out using X-ray diffraction, Mössbauer spectroscopy and thermomagnetic analysis (Fig. 1). The alloys' microstructure has been investigated using a scanning electron microscope (SEM) with EDAX analysis.

After arc-melting and without further annealing, the formation of the tetragonal $ThMn_{12}$ -type structure with Zr substitution for Nd and $x \geq 0.3$ has been observed. For $x<0.3$ the hexagonal $CaCu_5$-type structure is formed. The Curie temperature of 1:12 phase decreases linearly with Zr substitution from 574K for x=0.1 to 558K for x=0.8. The saturation magnetization increases from 111 emu/g (x=0.1) to 145 emu/gr (x=0.4), and then decreases for $x > 0.4$, the anisotropy field following the same trend. This study contributes to the search for magnetic phases, lean or free of critical raw materials, suitable for the production of permanent magnets.

1. A. Gabay and G. C. Hadjipanayis, J. Alloys Compds. 657 (2016) 133-137