EFFECT OF LA SUBSTITUTION ON $TB_5SI_2GE_2$ COMPOUND: STRUCTURAL AND MAGNETIC PROPERTIES

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The quest for improved magnetic materials which exhibit Giant Magnetocaloric Effect is a promising route for the development of magnetic refrigeration systems and a topic of intense research in the last years [1]. The most promising magnetic materials have been those which display a first order transition that usually combines both magnetic and structure components in special thus belonging to the $R_5(Si,Ge)_4$ system. Despite the intense research done in the past fifteen years, this system still attracts much attention due to its intriguing properties, namely its coupling between magnetic and structural orders. Therefore the chemical substitution emerges as an excellent tool to probe and study this system [2].

Herein, in order to study the crystal structure and magnetic properties of the system $Tb_{5-x}La_xSi_2Ge_2$, a series of polycrystalline samples with compositions x = 0, 0.075, 0.5, 0.75, 1, 2, 3, 4, 4.5 and 5 have been synthesized and characterized. At room temperature, two crystallographic structures have been detected: compounds in the concentration range $0 \leq x < 1$ present a Monoclinic $Tb_5Si_2Ge_2$-type structure, while the $x > 1$ compounds present a Tetragonal Zr_5Si_4- type structure. The unit cell volume increases linearly with La concentration, but with two different slopes: ~ 18 $Å^3$/ x and ~ 33 $Å^3$/ x, for $0 \leq x < 1$ (M) and $x > 1$ (T), respectively. In the Monoclinic region, an increase of T_C was observed, reaching a maximum value of $T_C \sim 154K$, at the x=0.75 composition. The samples that crystallized in the Tetragonal structure, exhibit a linear decrease of $T_C(x)$ with a slope of $\partial T_C / \partial x$ −38 K/ x, reaching almost 0 K for the x = 5 composition. A magnetic and structural x-T phase diagram of $Tb_{5-x}La_xSi_2Ge_2$ system in the temperature range 2-300 K is proposed. Finally, the results presented here suggest

that La substitution acts on the complex magnetic exchange interaction allowing a fine control of the magnetism of this compound.

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