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Effect of milling process over the structural properties of $Ni_2Mn_{1.44}Sn_{0.56}$ Heusler alloys

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Abstract – Here it has been investigated the effect of the milling over the structural properties of $Ni_2Mn_{1.44}Sn_{0.56}$ Heusler alloys prepared by voltaic arc furnace. The magnetic results show that the martensitic-austenitic phase transition tends to disappear when the milling process is applied. This fact is attributed to an addition of defects on the L_{21}-phase, changing the Mn-Mn distance, and consequently reducing the presence of incipient antiferromagnetic phase, responsible for the structural phase transformation.

The NiMn-based Heusler alloys [1] have recently attracted special attention of the scientific community in the last decade due to their potentials for technological applications. The remarkable physical properties of the NiMn-based Heusler alloys are inherently associated with the martensitic phase transformation [2], which occurs from a highly symmetrical parent cubic phase (*Fm3m*) to a lower symmetry structure (*Pmma*), as observed in Mn-rich $Ni_{50}Mn_{50-y}Sn_y$ compounds.

In this work, we present a systematic study on the martensitic-austenitic phase transition of the antiferromagnetic martensitic $Ni_2Mn_{1.44}Sn_{0.56}$ compound submitted to a milling process.

Room temperature XRD patterns of the milled alloys shown the L_{21}-phase (austenitic), indicating that the milling process does not induce phase structural transformation. However, it has been observed in the hysteresis curves M(T) recorded at 5 T for different milling times that the martensitic-austenitic phase transition reduces when the milling time increases, as can be seen in figures 1 and 2, which show the field cooling (FC) and field heating (FH) curves for as prepared and 1.5 minutes milled samples, respectively. The complete absence of the phase transformation occurs after milling times longer than 2 minutes.

Since the phase structural transformation in the $Ni_2Mn_{1.44}Sn_{0.56}$ compound is mainly based on the incipient antiferromagnetic interaction and the XRD patterns are from the austenitic phase, the absence of the martensitic phase transformation may be explained by the addition of defects on the L_{21}-phase, changing the Mn-Mn distance, and consequently reducing the presence of incipient antiferromagnetic phase, responsible for the structural phase transformation.

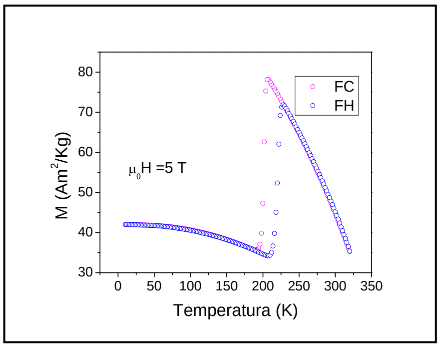

Figure 1: Field cooling (FC) and field heating (FH) curves of as prepared $Ni_2Mn_{1.44}Sn_{0.56}$ Heusler alloy.

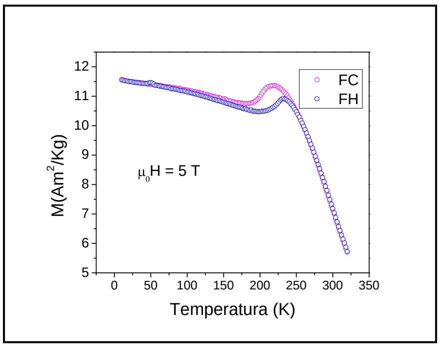

Figure 2: Field cooling (FC) and field heating (FH) curves of $Ni_2Mn_{1.44}Sn_{0.56}$ Heusler alloy milled during 1.5 minutes.

References

[1] K. Thorsten et al., Nature 4, (2005) 450.
[2] O. Tegus et al., Nature 415, (2002) 150.