Curie temperature dependence on Ni content for series of amorphous $(Fe_{100-x}Ni_x)_{81}Zr_7B_{12}$ alloys

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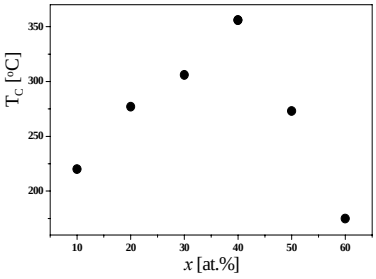
Nanostructures formed during primary crystallization at the first crystallization stage of recently obtained amorphous $(Fe_{100-x}Ni_x)_{81}Zr_7B_{12}$, x=10, 20, 30, 40, 50, 60 alloys, depend on the Ni content and are largely independent on B content [1]. Crystals of about 23 nm in diameter are embedded in an amorphous matrix. Such soft magnetic materials have many technical applications.

The glassy state of melt-spun as-quenched ribbons was verified by X-ray diffractometry (XRD) and by differential scanning calorimetry (DSC). The T_C was determined using a (TMAG) ac-susceptometer. The TMAG measurements for all compositions were carried out at a heating rate of 100 K/min .



The XRD measurements show clearly an amorphous halo with the size of coherently scattering domains of about 1.2 nm. The DSC continuous heating measurements reveal a glass transition temperature. Consequently, the melt-spun ribbons have a truly glassy state. However, the influence of the structural relaxation processes on T_C could also appear in amorphous alloys [2]. Moreover, the initial crystallization temperatures of the tested alloys are higher than T_C values. The dependence T_C vs. Ni content of as-quenched melt-spun ribbons is presented in the included Figure. With Ni content increasing from 10 to 30 at.%, the T_C of amorphous alloys increases and exhibits its maximum at 355°C for 40 at.% Ni. After that it decreases to 177°C for 60 at.% Ni.

Summarizing, a series of amorphous $(Fe_{100-x}Ni_x)_{81}Zr_7B_{12}$, x=10-60 alloys were studied by XRD, DSC and TMAG techniques. The amorphous $Fe_{41}Ni_{40}Zr_7B_{12}$ alloy exhibits an improved thermal stability of magnetic properties in the examined series of amorphous alloys. The Curie temperature T_C, being an intrinsic magnetic property, strongly depends on the alloy composition. With a decreasing content of Fe (for *bcc*-Fe T_C=771°C), *i.e.* with an increasing Ni (for *fcc*-Ni T_C=354°C) content, the values of T_C usually decrease because of addition of Ni with relatively low T_C. So, in this sense the experimental T_C measured for investigated alloys behaves in an unusual way. The influence of the local order in the amorphous state may explain this behaviour, because for x<40 (see the enclosed Figure) the alloy crystallizes into the *bcc*-(Fe,Ni) while for x>40 into the *fcc*-(Fe,Ni) structure.

[1] A.L. Greer, I.T. Walker, J. Non-Cryst. Solids. **317** (2003) 78.
[2] *Amorphous Metallic Alloys*, F.E. Luborsky (ed.), Butterworths Monographs in Materials, Butterworths (1983).

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