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Magnetocaloric effect in partially Co-substituted melt-spun $Gd_{65}Fe_{20-y}Co_yAl_{10}X_5$ (X = Si, B) system

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Effective refrigeration using magnetocaloric materials has great attention because is energy efficient alternative to the existing vapor-compression technology. Among the recently designed magnetic refrigerant materials, the Gd(TM)Al-based amorphous alloys prepared by melt-spinning combine favourable magnetic entropy characteristics with sufficiently high effective magnetic moment per volume.

In this work [1], we report on Fe/Co substitution dependence of the magnetocaloric behaviour of melt-spun GdFeAl-based ribbons. The results obtained for the $Gd_{65}Fe_{10}Co_{10}Al_{10}B_5$ ribbon are very promising and surpass the characteristics reported for the parent Co-free $Gd_{65}Fe_{20}Al_{10}B_5$ alloy [2]. Maximal magnetic entropy change (ΔS_M) under 50 kOe reached 7.02J/kgK at 150 K in comparison with 5.17 J/kg K at 197 K for the latter one. The refrigeration capacity (RC) value under 50 kOe for $Gd_{65}Fe_{10}Co_{10}Al_{10}B_5$ ribbon was calculated to be 766 J/kg, which is slightly higher than that reported for the parent Co-free alloy [3]. The values of refrigeration capacity were determined as the area below the S_M peak with the integration limits corresponding to the temperatures at its half maximum. The same evidence was performed for $Gd_{65}Fe_5Co_{15}Al_{10}Si_5$ and $Gd_{65}Fe_{15}Co_5Al_{10}Si_5$ specimens. The maximal ΔS_M value under 50 kOe is 6.81 J/kgK at 155 K, while for the second one the maximum of the ΔS_M has slightly lower value but is shifted up to 195 K. The enhanced values of ΔS_M extended over a wide temperature range together with the good magnetic softness leading to the low hysteresis losses make the partially Co-substituted GdFeCoAl(Si,B) amorphous ribbons promising magnetic refrigerants in the temperature range from 80 to 220 K.

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