Nanocomposites and nanomaterials

Gradient distribution of martensite phase in melt-spun ribbons of Fe-Ni-Ti-Al alloy

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Metallography, X-ray diffraction and magnetometric analysis were used to study regularities of martensitic transformation in melt-spun ribbons of a Fe – 28 wt. % Ni – 2.1 wt. % Ti – 2 wt. % Al – 0.05 wt. % C alloy. X-ray analysis indicated a significant texture of austenite. The substantial differences in volume fractions of the martensite phase in local regions of thin melt-spun ribbons of the alloy are related to the size effect of the transformation and structural nonuniformity of the ribbons. Owing to different cooling rates in different regions of the ribbons, differences in the size of austenite grains formed at the contact and free surfaces and across the ribbon are observed. The amount of martensite formed during cooling depends on the austenite grain size.

The principal factor for changing the completeness of the martensitic transformation is the size effect of transformation. The distribution of austenitic grain size in different local areas of melt-spun ribbons is significantly different. The difference in the martensite volume fraction in local regions of a ribbon is mainly determined by the different volume fraction of ultrafine grained (500 – 1000 nm) and nanosized (80 – 100 nm and less) initial austenite grains, in which the transformation was slowed down or completely suppressed. Indeed, an analysis of the microstructure of thin melt-spun ribbons shown that the sizes of initial austenitic grains correspond to the range of realization of the size effect of transformation. Other factors almost do not affect the completeness of the martensitic transformation. The strong stabilizing effect of the reverse – α transformation with respect to the subsequent direct – α transformation in the melt-spun ribbons is also related to the size effect.