Magnetic phase transitions in $La(Fe_{0.88}Si_x Al_{0.12-x})_{13}$ (x = 0.033 and 0.096) compounds

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Magnetic phase transitions in $La(Fe_{0.88}Si_xAl_{0.12-x})_{13}$ (x = 0.033 and 0.096) compounds

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Abstract

Magnetic properties, structure parameters, linear thermal expansion, and Mössbauer effect have been measured on intermetallic compounds $La(Fe_{0.88}Si_xAl_{0.12-x})_{13}$ (x = 0.033 and 0.096) with the ground ferromagnetic state. The compound with $x = 0.033$, on growing temperature, demonstrates a transition to antiferromagnetic state at $T_{F\text{-}AF}$ ~ 140 K and then paramagnetic state at T_N = 190 K. The compound with $x = 0.096$ is a ferromagnet with T_C = 190 K, and the transition to paramagnetic state is of the first order. The ferromagnetic ordering is accompanied by the lattice expansion by 0.5% and 1.2% for compositions with $x = 0.033$ and 0.096, respectively. It is established, based on the results of fitting of Mössbauer spectra, that the antiferromagnetic state is predominantly featured by the subspectrum with a positive quadrupole shift, whereas in the ferromagnetic state approximately equal contributions with the quadrupole shifts of different signs are observed.

Keywords: Rare-earth intermetallics; Magnetic phase transition; Hyperfine interactions; Magnetic ordering; Crystal structure.

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