

Achieving a linear magnetostrictive effect in textured MnCoSiGe alloys

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TiNiSi-Type MnCoSi alloys have attracted much attention as a potential magnetostrictive material, owing to the magnetic-field-induced metamagnetic transition. In the present work, the textured bulk MnCoSi alloys with [100]o preferred orientation were prepared by a multi-stage thermal treatment. Giant magnetostriction was achieved as much as -5268 ppm in the [100]o oriented stoichiometric MnCoSi alloys at 300 K and under a magnetic field of 3 T. The substitution of Si with Ge element results in a linear magnetostrictive behavior in the [100]o oriented MnCoSi_{0.84}Ge_{0.16} alloys, which means that large magnetostriction can be obtained under a low magnetic field. The magnetostriction for the MnCoSi_{0.84}Ge_{0.16} alloys reaches up to -327 ppm and -330 ppm under a magnetic field of 0.5 T at 280 K and 300 K, respectively. In a magnetic field of 1 T, the magnetostriction of the MnCoSi_{0.84}Ge_{0.16} alloys is -923 ppm and -821 ppm at 280 K and 300 K, respectively. Through the systematic investigation of the crystal structure, microstructure, and magnetic properties of the MnCoSiGe alloys, the achievement of a linear magnetostrictive performance is ascribed to the enhancement of magnetization and decreasing of the width of martensite variants. Our work greatly enhances the low-field magnetostrictive performance of MnCoSi-based alloys and makes them of interest in potential applications.

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