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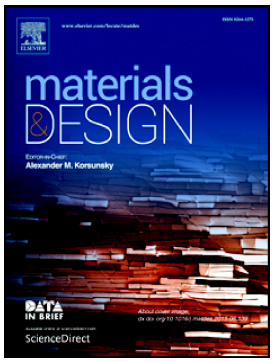

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Role of Mn and Cr on structural parameters and strain energy during FCC-HCP martensitic transformation in Fe-Mn-Cr shape memory alloys

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Abstract

Fe-Mn-based alloys show the shape memory effect which is mainly related to the FCC-HCP martensitic transformation. Cr is one of the additional elements which improve the properties of these alloys. In the present work structural data are obtained for the FCC austenite, and both martensitic structures, HCP and BCC, for an extended composition range where the FCC-HCP transition takes place. Lattice parameters are determined by X-Ray diffraction measurements performed at room temperature. The volume change between the austenite and each martensitic structure plays a significant role on relevant properties for martensitic transformations, like the strain energy associated to the transition. The effect of Mn and Cr on lattice parameters and volume change between FCC and HCP is determined and modeling of the data is presented. This result allows estimating the strain energy associated to the phase change. By using this information, the strain energy contribution to the balance of energy for the HCP nucleation is discussed. The addition of Cr decreases the volume change between FCC and HCP for contents larger than 12 wt.% Cr which leads to a decrease of the strain energy. Both effects favor an increased shape memory effect associated to the FCC-HCP martensitic transition.

Keywords

Fe-Mn-Cr; MARTENSITIC TRANSFORMATIONS; VOLUME CHANGE; LATTICE PARAMETERS; STRAIN ENERGY

1. Introduction

Fe-Mn-based alloys are attractive due to the shape memory effect (SME). In these alloys the SME is related to the FCC-HCP martensitic transformation. The SME has been optimized in Fe-Mn-Si-Cr-Ni alloys where a fully reversible 8% deformation has been obtained [1]. This property in addition to the low nominal cost of these steels make them promising candidates for technological applications [2,3]. Large recovery strains have been reported in Fe-Mn-based alloys containing multiple elements. However, there is a lack of knowledge on the effect of each element on structural and functional properties.