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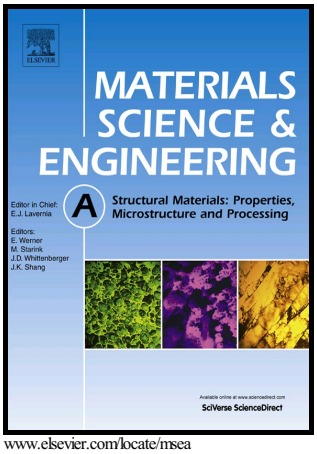

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Influence of Equal Channel Angular Pressing on High Cycle Fatigue Behavior of Ultrafine-Grained Iron: Role of Anisotropy

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Abstract

The high cycle fatigue behavior of ARMCO® Iron processed by equal-channel angular pressing (ECAP) was investigated for routes A and B_C, which results in ultrafine-grained microstructures with high and low grain elongations, respectively. Rotating bending fatigue tests along two different testing directions show a significant anisotropy in the fatigue strength for route B_C but only marginal differences for route A, in spite of the higher grain elongation and stronger crystallographic texture that is generated by route A. Still, the fatigue damage at the surface of samples processed by route A is highly anisotropic, as it is confined to regions with a certain alignment of the microstructural elongation plane with regard to the surface plane. The anisotropy in high cycle fatigue strength for route B_C as well as the surface orientation dependent resistance to fatigue damage for route A are discussed with regard to the alignment of the shear plane during the last ECAP pass and the correlation between the microstructural morphology and subgrain coarsening that lead to fatigue crack initiation.

Keywords: fatigue; severe plastic deformation (SPD); ultrafine grained microstructures; anisotropy; iron alloys; electron microscopy

1. Introduction