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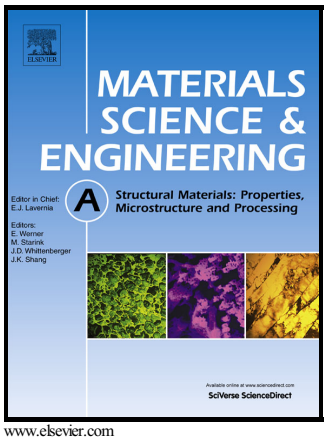

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Structural transition and softening in Al-Fe intermetallic compounds induced by high energy ball milling

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ABSTRACT

In the present investigation, powders of as-cast ingots of Al-25 at.%Fe and Al-34.5 at.%Fe alloys close to Al_3Fe and Al_2Fe intermetallic phases are subjected to high energy ball milling to understand the possibility of formation of amorphous and/or nanocrystalline phases or any other metastable phases. The development of microstructure, evolution of various metastable phases and their stability are investigated by x-ray diffraction (XRD) and transmission electron microscopy (TEM) techniques. Mechanical milling of the alloys, up to 50 h, was carried out in high energy planetary ball mill. It resulted in phase transformation from monoclinic and triclinic structures of Al_3Fe and Al_2Fe, respectively, to orthorhombic structure pertaining to Al_5Fe_2 phase and structural transformation from crystalline to amorphous phase. Hardness measurements revealed a transition from hardening to softening behavior in these mechanically milled alloys undergoing prolonged milling. The softening effect in the milled powders, having a composite structure involving nanocrystalline and amorphous phases, is attributed to the competing phenomenon of grain size reduction and amorphous phase formation with increasing milling time.