The effect of carbon addition on the structure and high – temperature strength of Fe_3Al – based iron aluminide doped by niobium

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Abstract:

A structural study as well as the determination of $\sigma_{0.2}$ compression yield stress at high temperatures have been performed on the Fe_3Al-based iron aluminide doped by Nb (5 at. %) and C (1.5 at.%). The carbon occurrence leads to the formation of three-phase structure. Fe3Al matrix, niobium carbides and (Fe,Al)2Nb Laves phase were observed in the structure of investigated alloys. Precipitates were inhomogeneously distributed in as cast state alloy. The annealing at 1000°C for 50 hours leads to more homogenously distribution of secondary phase particles and also to refinement of grain size. The strengthening mechanism of material at high temperatures was detected as a combination of strengthening by incoherent precipitates (NbC and Laves phase) and a solid solution hardening by Nb atoms. Effect of two reinforcing mechanisms together with homogeneously precipitate's distribution increase the values of $\sigma_{0.2}$ compression yield stress about 50 MPa in whole measured temperature range (600 – 800 °C) in comparison to similar intermetallic's system Fe-Al-Zr-C.

Phase composition of the alloy was studied by means of scanning electron microscopy (SEM) equipped by energy dispersive X-ray spectrometer (EDX). The electron backscattered diffraction (EBSD) was used for phase verification and grain size visualization.

Key words:

Fe_3Al – type iron aluminides, niobium and carbon addition, phase structure, heat treatment, high temperature $\sigma_{0.2}$ compression yield stress