EBSD STUDY OF THE CRACK PROPAGATION IN THE Fe_3Al BASED INTERMETALLIC ALLOY

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The fatigue fracture properties of the hot rolled Fe-28at.%Al intermetallic alloy with the addition of chromium and cerium were characterized. The crack growth rate (v–ΔK curve) was measured at room temperature. Fractographic analysis revealed several failure mechanisms. The main failure mechanism was transgranular cleavage. The influence of the microstructure (especially of the crystallographic orientation and the shape of grains) on the crack growth was pointed out by EBSD. All observed cleavage facets were parallel to {100} crystal planes.

Key words: *iron aluminides, fatigue crack growth, fractography, EBSD*

1. Introduction

Fe_3Al based intermetallic alloys are potentially important structural materials for moderate and high temperature applications owing to their high specific strength, good wear resistance, superior corrosion resistance in oxidizing and sulfidizing atmospheres, low material cost, ease of fabrication, availability of raw materials and conservation of strategic elements [1]. Details of fatigue properties of these materials are described in [2, 3].

In this paper, the fracture micromechanisms in Fe-28Al-3Cr-Ce (at. %) alloy were studied in specimens broken under cyclic loading. In addition to the classical scanning electron microscopy, Electron Backscattering Diffraction (EBSD) technique was used in order to determine the crystallographic orientations of facets found on fracture surfaces. The aim of this study is to contribute to a better understanding of the influence of the microstructure (especially crystallographic orientations) on the mechanisms of the crack propagation in Fe_3Al-based alloys.

2. Experimental details

An alloy with a nominal composition of Fe-28Al-3Cr-0.02Ce (at. %) was prepared by vacuum induction melting and casting. The ingot was hot rolled at 1100 °C to a plate 6 mm thick (reduction 75 %) and quenched into oil. The thermal treatment consisted in annealing for 2 h at 700 °C (above the temperature of the $D0_3$-B2 order-order transition) to relieve internal stresses and subsequent quenching to mineral oil to avoid environmental embrittlement.

Fatigue crack growth experiments were performed on a 5 mm thick standard compact tension (CT) specimens of thickness $B = 5$ mm and width $W = 40$ mm. The notch was prepared by electro-discharge cutting using a wire 0.1 mm in diameter. The initial crack length

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