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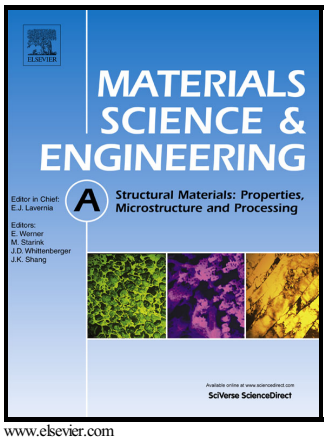

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ACCEPTED MANUSCRIPT

Influence of γ′ precipitates on Portevin-Le Chatelier effect of Ni-based superalloys

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Abstract

The γ′ precipitate plays a critical role in improving the mechanical properties of Ni-based superalloys. An undesirable phenomenon referred to as the Portevin-Le Chatelier (PLC) effect always appears in Ni-based superalloys deformed within specific ranges of strain rate and temperature. In order to systematically investigate the influence of the γ′ precipitates on the PLC effect, four Ni-based superalloys with various γ′ contents were designed and fabricated. Microscopic observations from transmission electron microscopy (TEM) indicated that the volume fraction of the γ′ phase was consistent with the designed value. Furthermore, analysis of energy dispersive spectroscopy (EDS) results revealed that the γ matrix of all the alloys consisted of the same components. Uniaxial tensile tests were performed at strain rates and temperatures ranging from 1×10^{-4}-3×10^{-3} s^{-1} and 300-500°C, respectively. We found that the ultimate strength increased while the elongation decreased with increasing γ′ content. In addition, the serration changed from type A to type B and to type C with increasing temperature, decreasing strain rate or increasing γ′ content; the amplitude of type B serrations was described by unimodal or bimodal distributions. Increasing volume fraction of γ′ precipitates shifted the region in which the PLC effect occurred, to the range of low temperatures and high strain rates. Moreover, the serration amplitude increased with increasing γ′ content at a given temperature, which indicated that the γ′ precipitate increases the dynamic strain ageing (DSA) effect.

Key words: γ′ precipitate; γ′ content; Ni-based superalloy; Dynamic strain ageing; Portevin–Le Chatelier effect

1. Introduction

Ni-based superalloys exhibit excellent mechanical properties even at elevated temperatures [1,

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