Accepted Manuscript

Experimental investigation and modelling of microstructure degradation in a DS Ni-based superalloy using a quantitative cross-correlation analysis method

Weiqing Huang, Shaolin Li, Xiaoguang Yang, Duoqi Shi, Hongyu Qi

PII: S0925-8388(18)31838-3

DOI: 10.1016/j.jallcom.2018.05.131

Reference: JALCOM 46107

To appear in: *Journal of Alloys and Compounds*

Received Date: 21 August 2017

Revised Date: 9 May 2018

Accepted Date: 10 May 2018

Experimental investigation and modelling of microstructure degradation in a DS Ni-based superalloy using a quantitative cross-correlation analysis method

Weiqing Huang [a], Shaolin Li [a, b, *], Xiaoguang Yang [a, b, *], Duoqi Shi [a, b], Hongyu Qi [a, b]

[a] *School of Energy and Power Engineering, Beihang University, Beijing 100191, China*

[b] *Beijing Key Laboratory of Aero-Engine Structure and Strength, Beijing 100191, China*

Abstract: In their operating environments, turbine blades usually suffer from microstructural degradation and a corresponding reduction in mechanical performance. Load-free and load-assisted experiments were conducted to determine the microstructural degradation kinetics of a directionally solidified (DS) Ni-based superalloy, DZ125, commonly applied as a first-stage blade material in aero-engines. The results show that a transition time from the linear law to the power law exists during isotropic coarsening in load-free testing. The directional coarsening behaviour of DZ125 under load-assisted intensifies with the increase in exposure temperature and applied stress. A unified analytical model for γ' precipitate evolution of DZ125 superalloys, based on Lifshitz-Slyozov-Wagner (LSW) theory, was proposed to predict the experimentally observed increase in the coarsening extent associated with increase in temperature, time, and applied stress. Microstructural information, such as γ' precipitate width and channel width in modelling work, was extracted using *the cross-correlation analysis algorithm*. The model can accurately estimate the γ′ precipitate evolution of DS DZ125 superalloys. In addition, based on the model, the analytical process derived for evaluating the service temperature and stress field of turbine blades was verified by data pertaining to the trailing edge of a turbine blade.

Keywords: microstructural degradation, coarsening, raft, modelling, analytical method.

* Corresponding author. Tel: +86 010 82316362; fax: +86 010 82316362;

E-mail address: lishaolin@buaa.edu.cn (Shaolin Li)

* Corresponding author. Tel: +86 010 82316362; fax: +86 010 82316362;

E-mail address: yxg@buaa.edu.cn (Xiaoguang Yang)