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

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**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  $\gamma'$  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  $\gamma'$  precipitate width and channel width in modelling work, was extracted using *the cross-correlation analysis algorithm*. The model can accurately estimate the  $\gamma'$  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.

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