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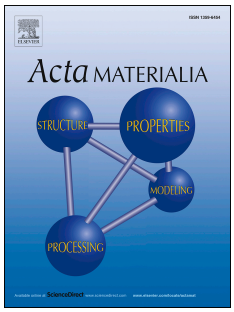

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V. Caccuri, R. Desmorat, J. Cormier

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Tensorial Nature of γ'-rafting evolution in nickel-based single crystal superalloys

V.CACCURI[1,2], R.DESMORAT[1], J.CORMIER[2]

[1] LMT Cachan (ENS Cachan, CNRS, Université Paris Saclay), 94235 Cachan, France

[2] Institut Pprime, UPR CNRS 3346, Physics and Mechanics of Materials Departement, ISAE-ENSMA, 1 Clément Ader, BP40109, 86961 Futuroscope-Chasseneuil, France

Abstract

Our work aims at providing a tensorial analysis of directional γ' rafting state in a nickel based single crystal superalloy, for several orientations. According to a visco-plasticity modeling accounting for microstructure evolution during creep (including rafting), different —even— order fabric tensor representations are provided, respectively for γ channel width, primary γ' cuboidal particles and microstructure periodicity λ. Several image processing algorithms are presented and used to best measure these quantities, particularly the AutoCorrelation Method (ACM) and the Rotational Intercept Method (RIM). Each method is developed for a specific purpose: the AutoCorrelation Method yields information about principal directions and pattern periodicity, while RIM method provides a polar distribution of a physical quantity. A methodology is proposed and applied to measure the Rose diagrams and the corresponding fabric tensors of order 2, 4, 6 and 8, starting by the best fitting Fourier series coefficients of the experimental data. When RIM method is possible to apply, fabric tensors up to order 8 are considered. In any case a 2^{nd} *order* tensor representation of single crystals γ' rafting state is provided.

Keywords: autocorrelation; cubic microstructure; image analysis; fabric tensor; Orowan stress; rafting;