

# Irreversible thermodynamics approach to plasticity: Dislocation density based constitutive modelling

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## Abstract

© 2015 Institute of Materials, Minerals and Mining. In this paper, we describe a simple methodology that offers a familiar constitutive description of plasticity in terms of the dislocation density evolution as an outcome of the approach based on the thermodynamics of irreversible processes. We further demonstrate that the dislocation density evolution approach can organically predict the critical strain corresponding to the Considère instability point. Finally, we show that the fractal dimension (FD) of the dislocation population of a deforming material can be integrated in the proposed modelling framework and, consequently, the FD behaviour can be traced, providing insights in the evolution of the dislocation structure in the course of deformation.

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## Keywords

Dislocation kinetics, Irreversible thermodynamics, Plastic deformation