Quantitative Infrared Lagrangian Thermography for the thermomechanical determination of the granular yield stress in a polycrystal

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abstract

Polycrystalline metallic materials are made of an aggregate of grains more or less well oriented with respect to the loading axis. During mechanical loading, the diversity of grain orientations leads to heterogeneous deformation. It is well known that most of the plastic work generated during the deformation process reappears in the form of heat whereas a certain proportion remains latent in the material and is associated with microstructure changes. To access the local stored energy during deformation processes, experimental energy balances are needed at a suitable scale. In this way simultaneous measurements of thermal and kinematic necessary fields have already been done in-house at the microstructural scale of a 316L stainless steel submitted to macroscopic monotonic tensile test. The aim of the present study is to propose a complete calibration strategy allowing the estimation of thermal variations of each material point along its local and complex deformation path. This point constitutes one of the key element within the experimental and granular energy balance achievement including two major experimental problems: the own dynamic of each IRFPA sensors leading to undesired spatial and temporal noise and the complexity of the local loading path which must be captured by simultaneous complementary measurement. The improvement of such multifield strategy will lead to the experimental and local achievement of energy balances required for the building of new energetically based criteria.

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