ON THE DEFORMATION AND FAILURE OF AL 6061-T6 EVALUATED THROUGH IN SITU MICROSCOPY

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Focus Material: Metals

Focus of the Presentation: Choose one.
(i) Physics-based multi-scale model development;
(ii) ***Multi-scale data acquisition, characterization and experiments at different scales****;*
(iii) Probabilistic modeling & uncertainty quantification;
(iv) Structure-material integration and design.

Abstract

Modeling of the inelastic response of metallic materials is of significant interest in applications in the aerospace, automobile, and naval industries. These models must encompass large inelastic deformations leading up to failure. While there are numerous investigations that postulate and implement micromechanical damage models such as the Gurson model to capture material degradation, there are very few investigations that provide quantitative experimental evaluation, both for calibration and for use structural applications. In this presentation, we provide a quantitative examination of the underlying deformation and failure mechanisms through a detailed, multiscale investigation of the deformation and failure processes in Al 6061-T6. Specifically, we utilize an in-situ loading stage in a scanning electron microscope and monitor both the macroscopic response and the local deformation and failure at high spatial resolution, identifying and quantifying the development of discontinuous deformation gradients both within grains and at grain boundaries [1]. The deformation and microstructural changes leading up to failure within the localized bands are identified, and the strain at the onset of final failure is determined at different (low) triaxiality levels. Issues related to homogenization of strain, representation and calibration of phenomenological plasticity, and mechanisms of failure will be discussed.

References

[1] Gross A.J., and Ravi-Chandar K. 2016, On the deformation and failure of Al 6061-T6 at low triaxiality evaluated through *in situ* microscopy, *International Journal of Fracture*, DOI: 10.1007/s10704-016-0078-x.