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Simulation-Aided Constitutive Law Development – Assessment of Low Triaxiality Void Nucleation Models via eXtended Finite Element Method

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Simulation-Aided Constitutive Law Development –
Assessment of Low Triaxiality Void Nucleation Models
via eXtended Finite Element Method

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Abstract

In this work, a multi-scale computational framework has been established in order to investigate, refine and validate constitutive behaviors in the context of the Gurson-Tvergaard-Needleman (GTN) void mechanics model. The eXtended Finite Element Method (XFEM) has been implemented in order to (1) develop statistical volume elements (SVE) of a matrix material with subscale inclusions and (2) to simulate the multi-void nucleation process due to interface debonding between the matrix and particle phases. Our analyses strongly suggest that under low stress triaxiality the nucleation rate of the voids \dot{f} can be well described by a normal distribution function with respect to the matrix equivalent stress (σ_e), as opposed to that proposed ($\bar{\sigma} + 1/3\sigma_{kk}$) in the original form of the single void GTN model. The modified form of the multi-void nucleation model has been validated based on a series of numerical experiments with different loading conditions, material properties,

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