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Jifeng Zhao, Oleg Y. Kontsevoi, Wei Xiong, Jacob Smith

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Jifeng Zhao

QuesTek Innovation LLC, 1820 Ridge Avenue, Evanston, IL, 60201, USA

Oleg Y. Kontsevoi

Department of Physics and Astronomy, Northwestern University, 2145 Sheridan Rd, Evanston, IL 60208, USA

Wei Xiong

Department of Mechanical Engineering and Materials Science, University of Pittsburgh, Benedum Hall, 3700 O'Hara Street, Pittsburgh, PA 15261, USA

Jacob Smith

Department of Mechanical Engineering, Northwestern University, 2145 Sheridan Rd, Evanston, IL 60208, USA

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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