Void size and shape effects in a gradient enhanced continuum model

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ABSTRACT

The combined effect of length scales and void shape in a strain hardening porous solid is investigated using both the Gurson-Tvergaard (GT) [1,2] and the Gologanu-Leblond-Devaux (GLD) [3,4] models enriched by a constitutive length parameter. The results are compared with unit cell calculations of regularly distributed voids embedded in a strain gradient enhanced matrix material. The strain gradient theory proposed by Fleck and Willis [5], extended to finite strains [6], is adopted for the cell model. The strain gradient model allows for a material length parameter to enter the constitutive framework for dimensional consistency. The enriched GT model has the length parameter introduced through prefactors to the usual $q_1$ and $q_2$ factors, and has been proven to capture gradient effects until localization or severe void shape change [7]. Extending the GLD model in a similar fashion by introducing an intrinsic length parameter will provide the basis for investigation of the coupled effects of void size and void shape on both void growth and yield behaviour of porous metals. Unit cell calculations with prolate/oblate voids embedded in a gradient enriched matrix will be presented along with a comparison to the extended GLD model.

REFERENCES