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3D HOMOGENIZATION AND FAILURE ANALYSIS OF INTERPENETRATING METAL-CERAMIC COMPOSITES

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Interpenetrating composites show advantageous properties based, e.g., on their damage and thermal behaviour. However, the modelling is challenging due to their complex microstructures [1]. Particularly interpenetrating structures with a high volume fraction of one of the phases need enhanced modelling procedures that incorporate the characteristic features of the microstructures [2].

In this presentation, we introduce a new modelling technique for the generation and the numerical analysis as well as the multiscale homogenization of interpenetrating composite structures. We show formulations for the characterization of the mechanical properties in the scale bridging consideration of this material class. Furthermore, we investigate the damage behaviour of the interpenetrating microstructures. A model incorporating the plastic behaviour of the metal phase coupled with a damage formulation for the ceramic phase is presented to derive homogenized formulations of the microscopic behaviour. In comparison with experimental investigations, we examine the mechanisms of failure in the material microstructure and evaluate our modelling approach. Finally, based on the proposed approach, generated and reconstructed microstructures are compared and fundamental challenges considering topological aspects and characteristic parameters are discussed. Good agreement is found in the analysis of the macroscopic behaviour of generated and reconstructed microstructures compared with experimental findings showing the validity of the proposed method.

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