# Microcracking in Brittle Materials due to Thermal Expansion Anisotropy[1]

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## Abstract

Thermal cooling of a variety of polycrystalline materials from high processing temperatures results in microcracking due to thermal expansion anisotropy of single phases and/or thermal expansion mismatch between multiple phases. This study investigates the damage evolution in polycrystalline materials due to thermally induced microcracking using three-dimensional discrete lattice spring networks. In particular, the effect of grain size distribution on inter- and intra-granular microcrack nucleation, growth and coalescence is investigated. Realistic 3D microstructure based discrete lattice simulations include the interaction of grains in parallel planes and the additional crack propagation paths for growth and coalescence of cracks. Numerical simulations are also used to estimate the critical grain size below which nucleation of microcracks does not occur. This critical grain size plays an important role in designing material applications with improved fracture properties. This work also highlights the significant differences between 2D and 3D numerical simulation of thermally induced microcracking in polycrystalline materials.

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