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COMPUTER SIMULATION OF FRACTURE QUASI-BRITTLE CERAMIC NANOCOMPOSITES UNDER PULSE LOADING

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Multi-scale computer simulation approach has been applied to research the mechanisms of failure in ceramic nanocomposites under dynamic loading.
Damage nucleation and accumulation in quasi brittle ceramics nanocomposites were simulated under impact loadings.
The probability of fracture was estimated for $ZrO_2 - ZrB_2$, and $ZrO_2 - ZrB_2 - B_4C$ nanocomposites under pulse loadings of microsecond duration.
The computational models of a structured representative volume (RVE) of ceramic nanocomposites were developed using the data of structure researches on meso-, micro -, and nanoscale levels.
The critical fracture stress on meso-scale level depends not only on relative volume of voids and inclusions, but also on the inclusion cluster morphology.
Results of simulation show that damage of nano-composites may occur under stress pulse amplitude less than the Hugoniot elastic limit of the matrix.
The Hugoniot elastic limit of ceramic nanocomposites decreases with an increase of volume concentration of nano-void clusters.
The spall stress of ceramic nanocomposites depends on the relative volume of voids, the size of voids and inclusions. The spall strength increases non-monotonically with growth of the volume concentration of inclusions above than ~25 %.
Self-organization processes of the micro-damage nucleation and the mesoscale shear band initiation occur in the ceramic nano-composite under compression at high strain rates.
The shear strength degradation can be caused by nano-voids in the triple junction region of ceramic matrix grains.