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Computational Modeling of Deformation and Damage in Particle-Reinforced Composites

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The micromechanisms of deformation and fracture in particle-reinforced composites are studied through the finite element simulation of 3D multiparticle cubic cells. The particle distributions within the cell were generated to represent composites with homogeneous and heterogeneous (clustered) microstructure. Damage in the matrix was introduced by the modified Gurson model while reinforcement fracture and decohesion at the matrix/reinforcement interface were included using three-dimensional interface elements, the interface and/or particle strength and toughness being given by the constitutive equation of the cohesive crack. The simulations provided new insights on the role played by reinforcement clustering and damage (particle fracture, interface decohesion, ductile matrix failure) on the overall composite tensile response as well as on the micromechanisms of damage nucleation and growth.

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