

The singular perturbation analysis in the modeling of fracture using a new multiscale theory

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Abstract

In the effort of coupling classical continuum mechanics with quantum mechanical calculations, we encountered a nonlinear boundary value problem from a novel approach to modeling fracture of a brittle material. Our approach leads to an interesting analogy with boundary layer theory. Within the interfacial region the effects of the intermolecular forces must be preserved. Outside the interfacial region (about 100nm beyond the phase interface) the effects of intermolecular forces are neglected. As people did in boundary layer theory, we used singular perturbation method and obtained interesting results. Because of the complicate physical features of the problem, there are multiple perturbation parameters. At our current thinking, more rigorous mathematical analysis is needed.