Damage amplification due to singularly interacting nearby microcracks and cavities.

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ABSTRACT

The singular stress amplification in the ligament between holes and nearby cracks is obtained as a function of the ligament thickness , either by asymptotic analysis of the full solution or by matched inner and outer expansions, with the inner region behaving as a beam ([1],[2], [3]) This asymptotic solution allows the study of the effect of micro-defect interaction on the homogenized coefficients of a two-scale damage model of periodic microstructure (figures 1 and 2), with cells containing pairs of interacting microcrack separated by a thin ligament ([4], [5]). The damage model that results from energy-release rate based microcrack propagation laws exhibits damage acceleration due to the singular interaction of the microcracks. The local macroscopic response expresses the collective coalescence of a periodic microstructure with interacting microcracks. For infinitely small ligaments, the macroscopic damage energy-release rate becomes infinite as 1 over the square root of the distance between the near-by tips of the microcracks. This leads to damage amplification as the result of the interaction of microcracks. Analogous analysis is performed for interacting near-by cavities.

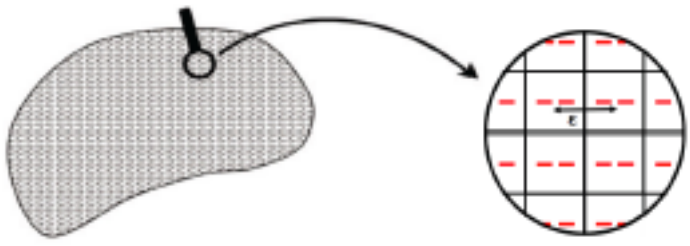

Figure 1. Fissured medium with locally periodic microstructure.

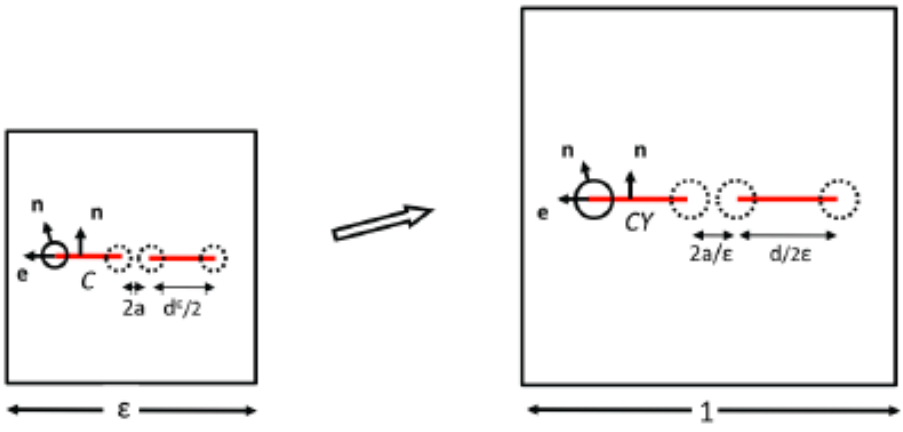

Figure 2. Rescaling of the unit cell to the microstructural period of the material.

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