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Numerical crack path prediction under mixed-mode loading in 1D quasicrystals

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Abstract

Quasicrystals are being implemented in industry since this new class of materials appears to have some peculiar properties. However, the fracture behaviour of quasicrystals is not yet clear, which could be a hindrance to its wide usage. This work adopts the generalized linear elastic framework of fracture theory in quasicrystals and develops numerical tools in a finite element environment to compute the fracture quantities. Crack growth is simulated in diverse specimens undergoing an intrinsic mixed-mode loading and the influence of the phonon-phason coupling effect on crack paths is investigated.

Keywords: quasicrystal, crack path prediction, numerical simulation, phonon-phason coupling, finite elements

1. Introduction

Quasicrystals, abbreviated as QCs, are a new class of materials and have been widely acknowledged for about 3 decades [1]. The QCs have special atomic or molecular structure, neither like crystals which have the rigorous periodic atomic arrangement and the symmetric point group, nor like amorphous solids where the atoms are totally disordered. In diffraction patterns of QCs, sharp peaks can be found and they exhibit 5-, 10-, 12-fold or some other orientational symmetries, which are disallowed for classic crystals. It denotes that the QCs have long-range orientational order but no translational symmetry. The distribution of atoms is quasiperiodic rather

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