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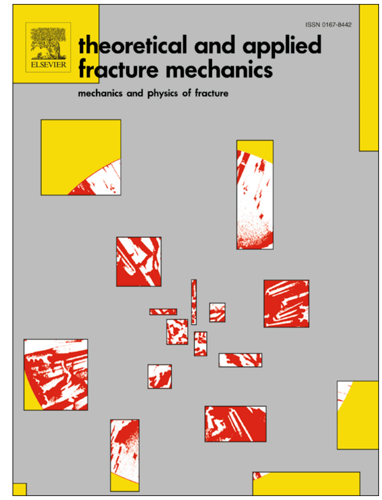

Is the crack opened or closed in soft-matter pentagonal and decagonal quasi-crystal

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Is the crack opened or closed in soft-matter pentagonal and decagonal quasicrystal

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Abstract The hydrodynamic model for possible pentagonal and decagonal soft-matter quasicrystals is investigated, the effect of fluid which describes the difference of fracture theory between traditional structural material and the present novel material is considered. With this model, taking into account of equation of state, a complete hydrodynamics analysis is carried out. In the plane field of the soft-matter quasicrystals, the phonon, phason and fluid fields in time-spatial domain are quantitatively explored. A fluid stress intensity factor is suggested for the first time, whose physical action here leads to the closing of the crack surface, so is different from that of elastic (or phonon) stress intensity factor which leads to opening of the crack surface. The authors consider the cracking process of soft-matter quasicrystals is a process of competition between action of elastic stress and fluid stress to each other. In other words, the situation around the crack tip of the matter in stable or unstable lies in the competition results.

Keywords: soft matter, quasicrystals, hydrodynamics, equation of state, crack, dynamic stress intensity factor

1. Introduction

Soft matter includes a large variety of systems, from polymers to colloids, from liquid crystals to surfactants, and from soap bubbles to solutions of macromolecules. 12-fold symmetry quasicrystals were observed in liquid crystals, colloids and polymers [1-4] since 2004, and 18-fold symmetry quasicrystals were discovered in colloids in 2011 [5]. More recently Cheng et al observed the 12-fold symmetry quasicrystals in surfactants [6]. All of these materials are of increasing industrial importance. At the same time, cracks in materials cannot be ignored. For example, in the assembly of large-area, highly ordered, crack-free inverse opal films, the formation of cracks should be avoided [7]. Streamlining the optimization of adhesive microstructures for industrial applications, crack formation at the edge or at the inner is completely inhibited [8]. During the strain relaxation process of a bilayer film, crack formation should be prevented [9]. The resistance to crack propagation by suppressing the stress concentration at the crack tip is enhanced [10]. In mud [11], crack patterns are frequently seen with either an approximately rectilinear or hexagonal tiling. Although undesirable in most industrial cases, crack patterns exhibit

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