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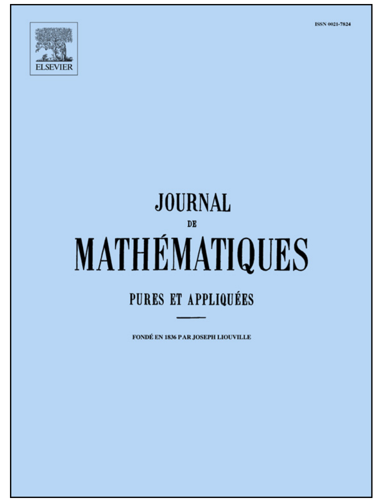

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A model for dislocations in epitaxially strained elastic films[☆]

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Abstract

A variational model for epitaxially strained films accounting for the presence of dislocations is considered. Existence, regularity and some qualitative properties of solutions are addressed.
Résumé: Um modèle variationnel pour les films épitaxialement tendus tenant compte de la présence de dislocations est considéré. L'éxistence, la régularité et certaines propriétés qualitatives des solutions sont abordées.

Keywords: Epitaxially strained elastic films, misfit dislocations, free boundary problems, regularity
2000 MSC: 49J10, 49J40, 74K35, 74B05

1. Introduction

The ability to control the morphology of elastically stressed thin films is paramount in the manufacturing of microelectronics and optical devices. Due to the misfit between the film and the substrate lattice constants, the film may undergo a morphological change, known as the Asaro-Grinfeld-Tiller (AGT) instability (see [4], [30]). This is a stress relief mechanism, by which the system decreases the elastic energy by allowing non-planar morphologies when a critical thickness is achieved. Such threshold effect is usually explained as the result of two competing forms of energy: the surface energy, which favors flat configurations, and the bulk elastic energy, which in turn is decreased by wavy or corrugated configurations.

An extensive literature is devoted to the modeling and to the numerical analyis of strained epitaxial films; see for instance [26], [46], [47], [48] and the references therein. Several variational models have been proposed to study epitaxial growth, both in the static case (see [5, 8, 9, 10, 11, 21, 25, 29]) as well as in the time-dependent setting (see [22, 23, 44]), starting with the free-energy approach of [31].

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