MATHEMATICAL MODELLING OF ATOMISTIC NEAR-CRACK-TIP PLASTICITY UNDER ANTI-PLANE SHEAR KINEMATICS

MACIEJ BUZE*

ABSTRACT

The term near-crack-tip plasticity refers to the phenomenon of atoms rearranging themselves in the vicinity of the crack tip due to stresses accumulated therein [1]. This rearrangement most prominently comes in the form of topological defects known as dislocations, which are carriers of plastic deformation [2]. Such deformations around the crack tip can potentially shield the material from further crack propagation [3], hence a proper understanding of the underlying mechanisms is of paramount importance in the context of structural integrity of materials used for engineering purposes.

In this talk I will present a new geometric and functional framework of a *lattice manifold complex*, which provides a natural setting for the study of atomistic near-crack-tip plasticity, as developed in recent work [4]. The framework is based on the discrete theory of crystal elasticity and dislocations in crystals, as developed in [5]. In particular, it extends the idea of a *lattice complex* to the case of the spatially inhomogeneous discrete domain of a cracked crystal. As a result, existence of locally stable equilibrium configurations containing both a crack opening and dislocations is established. Notably, with the boundary in the form of a crack surface accounted for, no minimum separation between a dislocation core and the crack surface or the crack tip is required.

The work presented here constitutes a foundation for several further studies aiming to put the phenomenon of near-crack-tip plasticity on a mathematically rigorous footing [6].

References

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* School of Mathematics, University of Birmingham, Edgbaston, Birmingham, B15 2TT, United Kingdom. Email: m.buze@bham.ac.uk