Γ-convergence analysis of systems of edge dislocations

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Dislocations are the most common defects in crystals and their presence is considered the main mechanism of plastic deformations in metals.

We shall consider the elastic energy induced by systems of straight edge dislocations in the framework of linearized plane elasticity. In this context, dislocations can be introduced as point topological defects of the displacement gradient fields. Following the core radius approach, we will introduce a parameter $\epsilon > 0$ representing the lattice spacing of the crystal and we will compute the elastic energy stored outside the core region, namely the union of the discs with radius ϵ centered at each dislocation. We shall analyze in terms of Γ-convergence the asymptotic behavior of the elastic energy as $\epsilon \to 0$. We will focus on the $|\log \epsilon|$ regime, showing a compactness result for sequence of configurations with logarithmic diverging energy. In particular, we will see as this analysis presents many similarities with the one of the Ginzburg-Landau functionals for the study of the vortices in superconductivity with specific difficulties due to the vectorial nature of the problem.

References

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