RESUMO - MODELAGEM DE MATERIAIS

INFLUENCE OF DEFECT SIZE ON THE VORTEX-INDUCED SUPERCONDUCTING DIODE EFFECT WITHIN THE GINZBURG-LANDAU FRAMEWORK

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In this work, we investigate the emergence and efficiency of the superconducting diode effect in type-II superconductors containing asymmetric pinning centers. Using the time-dependent Ginzburg--Landau (TDGL) formalism, we perform numerical simulations to analyze how geometric asymmetry in the defect shape governs the directional dependence of the critical current. The system is modeled through the finite-difference link-variable method, implemented on GPU-accelerated grids, allowing the accurate resolution of the complex order parameter Ψ and current--voltage (I--V) characteristics. We systematically vary both the applied magnetic field and the dimensions of the triangular defect to quantify the diode efficiency, defined as the relative difference between the positive and negative critical currents. The results reveal that the onset of vortex nucleation occurs at slightly lower magnetic fields for the defect-free configuration, while the presence of an asymmetric defect induces a pronounced rectification effect. These findings demonstrate that the interplay between vortex dynamics and structural asymmetry can be engineered to optimize diode-like behavior in superconducting materials, offering a pathway toward low-dissipation rectifiers and logic devices.

Palavras-chave: superconducting diode effect; asymmetric pinning centers; time-dependent ginzburg–landau.