Controlled Triangular Edge-Asymmetries as Means of Increasing Diode Efficiency in a Single Layer Superconductor

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The recent emergence of research surrounding the superconducting diode effect (SDE) has led to greater understanding of the theory underpinning the mechanism. Previous works have found that the introduction of defects on the edges of superconducting materials allows for the asymmetrical penetration of magnetic flux on the two edges of the material, thus resulting in different critical currents when an out-of-plane magnetic field orthogonal is applied. These non-reciprocal currents create a superconducting diode analogous to that of the semiconductor diode, which allows the current in a circuit to flow in one direction. The potential to build a logic circuit with superconducting materials, particularly for quantum computers, provides motivation for further research in order to increase the efficiency of these diodes. We hypothesized that the introduction of intentional edge defects will increase the efficiency. In this work, we examine the effects that intentionally introduced asymmetrical edges have on the diode efficiency of a pure vanadium superconductor. The voltage and current along a Hall bar geometry was measured under applied magnetic fields ranging from -50 to 50 Oe, orthogonal to the wafer. A maximum diode efficiency of around 50% was found, the highest yet for a single element material, indicating the potential effectiveness of intentional edge asymmetry as a mechanism to tune and enhance diode efficiency.

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