Habilitationsvortrag

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Kolloquium

Supercurrent diodes

physikalisches

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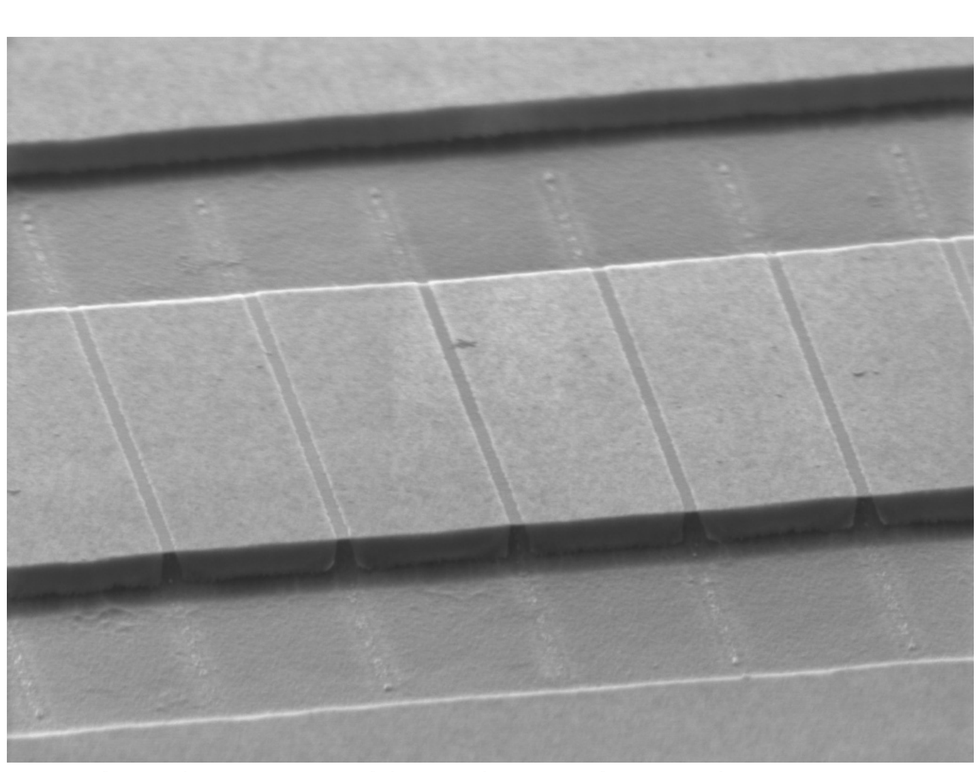
A semiconducting diode can rectify current because (1) we can distinguish its two - differently doped - terminals and (2) the current flow is dissipative, namely, we can distinguish the flow in one direction from its time-reversed version owing to the irreversibility of dissipative processes.

In a homogeneous, symmetric superconductor, reciprocity is doubly protected by two symmetries: terminals are indistinguishable at a macroscopic level and dissipationless supercurrent is protected by time-reversal symmetry. Here, I will show that noncentrosymmetric superconductors with large spin-orbit interaction - where space-symmetry is broken at a microscopic scale - can rectify supercurrent in the presence of an appropriate Zeeman field.

Such newly discovered supercurrent diode effect presents a valuable opportunity to investigate symmetry breaking in exotic superconducting systems and may offer a more accessible means of detecting topological phase transitions. From a technological perspective, supercurrent diodes might play a crucial role in fully superconducting circuits as those at the core of quantum computers.



Array of Josephson junctions fabricated starting from an Al/InAs heterostructure. The application of an in-plane field, acting on the electron spins, breaks the symmetry between the two directions of the supercurrent. Credits: Alexander Kirchner