Supercurrent Diode Effect in High Mobility Free-Standing InSb Nanoflags

Stefan Heun[1], Bianca Turini[1], Andrea Iorio[1], Sedighe Salimian[1], Matteo Carrega[2], Elia Strambini[1], Francesco Giazotto[1], Valentina Zannier[1], and Lucia Sorba[1]

[1] NEST, Istituto Nanoscienze-CNR and Scuola Normale Superiore, 56127 Pisa, Italy

[2] CNR-SPIN, 16146 Genova, Italy

Email: stefan.heun@nano.cnr.it

High-quality III–V narrow bandgap semiconductor materials with strong spin–orbit coupling and large Landé g-factor provide a promising platform for next-generation applications in the field of high-speed electronics, spintronics, and quantum computing. InSb offers a narrow bandgap, high carrier mobility, and small effective mass and, thus, is very appealing in this context. In fact, this material has attracted tremendous attention in recent years for the implementation of topological superconducting states. An attractive pathway to obtain two-dimensional (2D) InSb layers is the growth of freestanding single-crystalline InSb nanoflags [1]. We have demonstrated fabrication of ballistic Josephson-junction devices based on these InSb nanoflags with Ti/Nb contacts that show a gate-tunable proximity-induced supercurrent and a sizable excess current [2]. The devices show clear signatures of subharmonic gap structures, indicating phase-coherent transport in the junction and a high transparency of the interfaces. In an applied in-plane magnetic field, the device is driven into a non-reciprocal transport regime, where we observe an asymmetry between the critical current in opposite directions (see Fig. 1), modulated by the angle between in-plane field and current direction. This supercurrent diode effect is promising for superconducting electronic circuits and places InSb nanoflags in the spotlight as a versatile and convenient 2D platform for advanced quantum technologies.

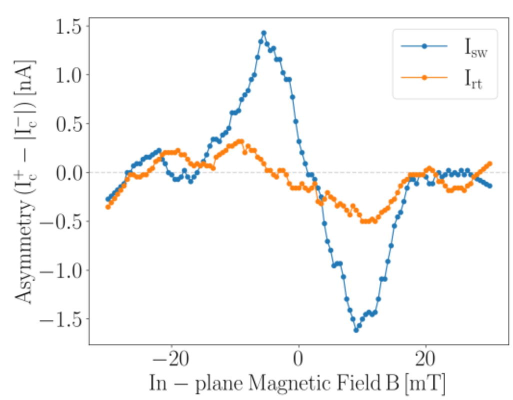

Figure 1: *Asymmetry in switching and retrapping current as a function of the applied in-plane magnetic field.*

References

[1] I. Verma et al., ACS Appl. Nano Mater. 4, 5825−5833 (2021).

[2] S. Salimian et al., Appl. Phys. Lett. 119, 214004 (2021).

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