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Probing graphene- superconductor interface in quantum Hall regime

At metal-superconductor interfaces, Andreev processes occur where an electron tunneling into the superconductor carries with it a second electron, effectively reflecting a hole with opposite momentum back into the metal. This is due to the superconducting gap, which, at low energies, only allows the formation of cooper pairs inside the superconductor, representing an accessible way to measure Cooper-pair tunneling phenomena. An important requirement for strong Andreev processes is a clean interface with a high transmission probability. Graphene is a promising candidate for achieving an extremely clean interface to superconductors[1], however recent results show achieving a transparent interface is non-trivial[2]. In this work, we use controlled assembly in inert atmosphere to create high-quality interfaces between graphene and superconductors. With dual graphite gated graphene, low disorder broadening around charge neutrality point (CNP) could be achieved, which gives opportunities to understand Andreev processes which happen near CNP. In addition, large upper critical fields of 2D superconductors allow us to reach different quantum hall states in graphene while preserving superconductivity. In this work, we report high field measurements of graphene/NbN junctions, in which NbN make edge contact to graphene. Transport measurements at zero field demonstrate clear features associated with both retro and specular Andreev reflection. Zeeman splitting is induced in graphene by applying in plane magnetic field. We observe changes in the Andreev spectrum that are consisting with spin splitting of the graphene band structure. This edge contact technique provides the opportunity to create hybrid SC/graphene or SC/QH system to illustrate new physics such as non-Abelian zero modes of Majorana physics.

References

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