Hybrid Graphene-Superconductor Devices

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An interesting consequence of the crystallographic structure of graphene is that its charge carriers are described as massless relativistic particles. The ability to isolate individual graphene layers therefore enables us to investigate relativistic phenomena in a solid state system. A particularly interesting method of probing this unusual electronic state is to interface graphene with superconducting materials whereby unique characteristics such as specular Andreev reflection are expected to be observed. While there is a wealth of theoretical work on superconducting graphene devices present within the literature there remains very little experimental work published to date. The vast majority of experimental work has so far concentrated on using Aluminium as the superconductor. We have investigated the use of Niobium which has a larger superconducting gap and allows for measurements at higher temperatures.

To further investigate the unique transport characteristics of graphene we are fabricating planar Josephson junctions using graphene as a barrier medium. Devices have been fabricated by mechanical exfoliation of graphite with single layer graphene flakes identified using Raman spectroscopy. Electron beam lithography was used to pattern contacts with separations of ~100nm which were subsequently sputter deposited with Pd/Nb using a DC magnetron. We present low temperature measurements taken on these devices showing evidence of Andreev reflection occurring at the graphene-superconductor interface. Andreev reflection is shown to be influenced by the application of a back gate voltage as well as being modified by low temperature current annealing.