INFRARED MEASUREMENTS IN SINGLE LAYER GRAPHENE

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Introduction

Graphene, a single atom thick sheet composed of carbon atoms arranged in a hexagonal lattice, has recently been the subject of intense investigation due to its unusual 2D bandstructure,[1-4] its relevance to the physics of nanotubes and fullerenes, and possible technological applications. To date its IR properties have not been explored experimentally, and the mesoscopic size of most graphene samples makes transmission measurements difficult. Over the course of four weeks of magnet time this year, our work at the NHMFL has progressed from zero signal to the first signs of IR absorption in graphene.

Experiment Design and Results

All experiments were carried out at 4K using an 18T superconducting magnet at the NHMFL. After failing to see any signal with the standard low-temperature FIR probe and small-area graphene samples, improvements were made in three directions. In fabrication, graphene samples with larger areas up to 3600 $\mu m^2$ have been made (see Fig. 1). We also designed and built a new dipper probe, shown in Fig. 2, utilizing direct optics and a parabolic focusing cone to improve the intensity of IR light incident on the sample. Finally, noise in this experiment has been a particular problem. Careful identification and elimination of ground loops has been key to increase the signal-to-noise ratio sufficiently to where we should see signals of IR absorption in single graphene sheets. Preliminary measurements on large area graphene devices following these improvements are indeed promising, providing the first hints of IR absorption in this material.

Fig. 1. Left, view of device shows 2.5mm x 2.5mm device; Right, closeup showing 3600 $\mu m^2$ graphene sheet.

Fig. 2. ‘XY’ dipper showing sample stage. The graphene device is located directly under the bolometer.

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References