Room temperature electronic localization in a single graphene layer on sapphire by He-ion irradiation

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Atomic disorder along a well-ordered conductive material gives rise to the well-known Anderson localization effect [1]. We use a He-ion beam irradiation with a 1 nm lateral precision to induce the required defects distribution in a single layer of graphene (SLG) to achieve electronic localization at room temperature. An ultra-flat sapphire substrate was used to support the graphene while preserving both its planarity and electronic properties. A 1% carbon defect density [2, 3] was induced line by line, irradiating with the He^+ beam a 100 nm-wide band on the graphene. This is increasing the SLG electrical resistance exponentially from 0.9 to 153 kΩ, demonstrating an overall localization length of 7.8 nm. This resistance build-up was monitored in-situ and in real time by measuring the *I(t)* time dependant current intensity through the SLG flake during the irradiation. For this purpose we used a shadow micro-mask to nanofabricate a metal-graphene-metal micro-junction (Figure 1). We report how the conductance decay during the process varies (Figure 2) which leads to a varying localization length. This is attributed to the local heating of the graphene surface caused by the irradiation. Such behaviour encourages carbon defects migration to the edge of the graphene flake [4], effectively moderating its electrical resistance increase after irradiations.

References

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Figures

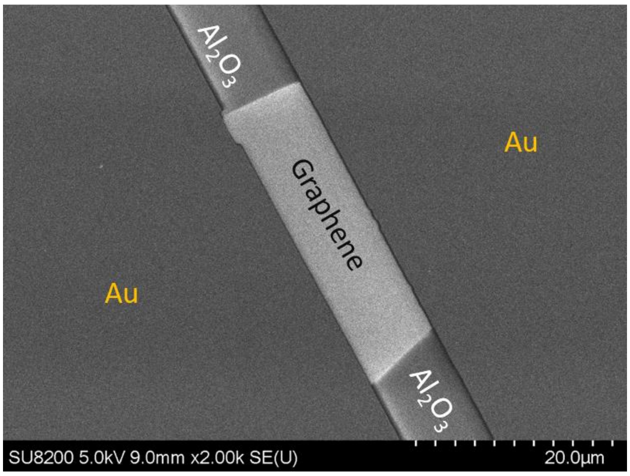

Figure 1: SEM micrograph of the Au-graphene-Au micro-junction.

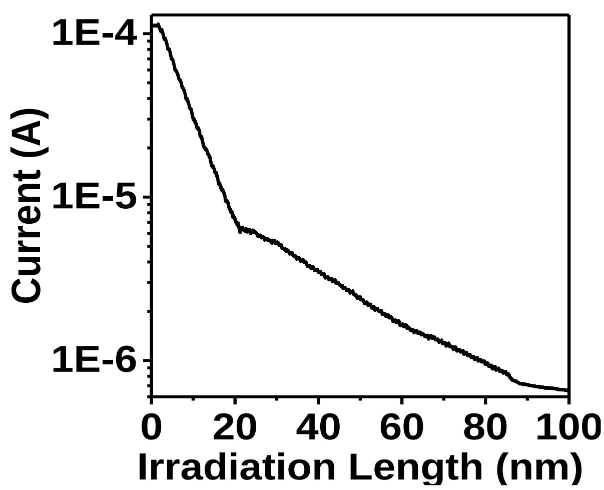

Figure 2: Room temperature electrical current intensity decay during He-ion irradiation of the graphene monolayer in the Fig. 1 junction. Applied bias 100 mV.