All-graphene electrical devices using graphene electrodes and chemically synthesized graphene nano-Ribbon

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Graphene nano-Ribbons (GNRs) are one-dimensional stripes of graphene, where quantum confinement can open a direct bandgap, moreover the GNRs proprieties are solely defined by the width and shape and can be precisely controlled by chemical synthesis. Combining the exceptional electrical proprieties of graphene with the chemically define proprieties of the GNRs can lead to a novel generation of (opto-)electronics devices.
Here we demonstrate a novel concept of device, where chemically-synthesized GNRs are employed as the active channel and graphene as the electrodes[1]. With respect to traditional metal contacts, the use of graphene offer the advantages of low-dimensionality and affinity with other carbon-based structures. We demonstrate field-effect transistor devices with on/off current ratio as high as 10^4, we report photoresponsivity as high as 6×10^5 A/W in the visible-UV range[2], orders of magnitude higher than pristine graphene. We report a systematic study using GNR with different morphologies, corresponding to different electrical properties, We show that the electrical behavior of the devices is in qualitative agreement with the expected band-gap as calculated by theory[3].

References

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[3] L. Martini et al., Carbon 146 (2019) 36-43.

Figures

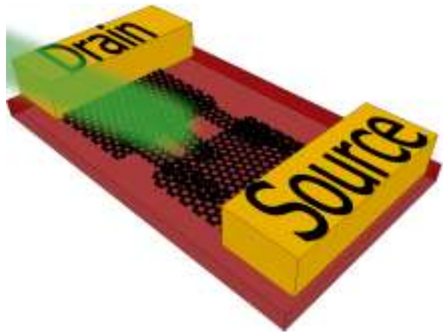

Figure 1: Schematic view of an all-graphene device: the graphene act as electrode, while the GNRs are the conductive bridge to provide electronical and opto-electronical properties.

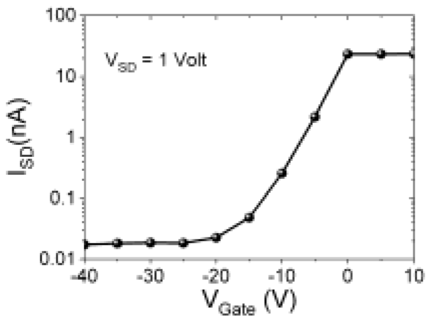

Figure 2: Transfer curve of a device: measured at 300 K, with a fix source-drain bias of one volt, in static vacuum conditions. The curve exhibit an n-type behaviour with high on/off ratio.