Micro and Nanoscale Mapping of Electrical Characterization of Graphene and Semiconductor Heterostructures

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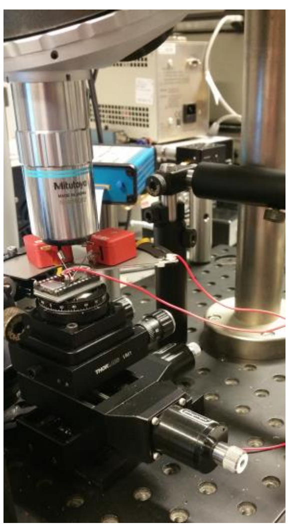
ABSTRACT

Graphene and 2D materials have proven to be promising materials to be used to fabricate heterostructures, and also promising candidate to be used in combination with optoelectronic devices, due to their unique electronic properties[1]. Here, the electrical properties of heterostructures, as well as the specific contacts area onto graphene are investigated by using properly designed test patterns. We firstly use PlayStation micro-probing (PSM) for macroscopic characterisations. Secondly, High- spatial resolution current mapping needed to provide an insight into the nanoscale mechanisms of electrical transport. We use scanning probe microscopy (SPM) as well as scanning gate microscopy (SGM), with a conductive diamond tip directly access to nano-resolution structures both topographically and electrically, with illumination and dark regimes. Additionally, we plan to report measurement in 2D materials heterostructures and their photoresponse on this regimes.

EXPERIMENTAL STUDY

1. Micro scale-probing Station (PSM) Measurements



The electronic transport properties of heterostructures have been characterised on the macroscopic scale by electrical measurements by Imina probes, as in Fig.1

2. Nanoscale- probing (SPM) Measurements

We have implemented an experimental set up based on scanning Probe Microscopy (SPM), by using a modified commercial atomic force microscope with a conducting probe and an appropriate method to measure and interpret the electrical transport properties of 2D materials such as graphene at the nanoscale regime. Our system allows nanoscale resolution measurement of local physical properties such as mapping of spreading resistance of graphene layers under environment conditions. This technique can provide new insight into the electrical transport properties at the nanoscale of 2D material nanostructures. The research objective is to assist in the development of electrical transport characterization methods and, of new electronic nanodevices.

RESULTS AND DISCUSSION

Here, we perform nanoscale measurements on InAsNWs, both topographically and electrically by SSRM, as well as captured (I-V) curves with/without illumination. Bottom figure (right) shows graphene/MoS_2/graphene layers stacks on each other performing by PSM with changing backgate.

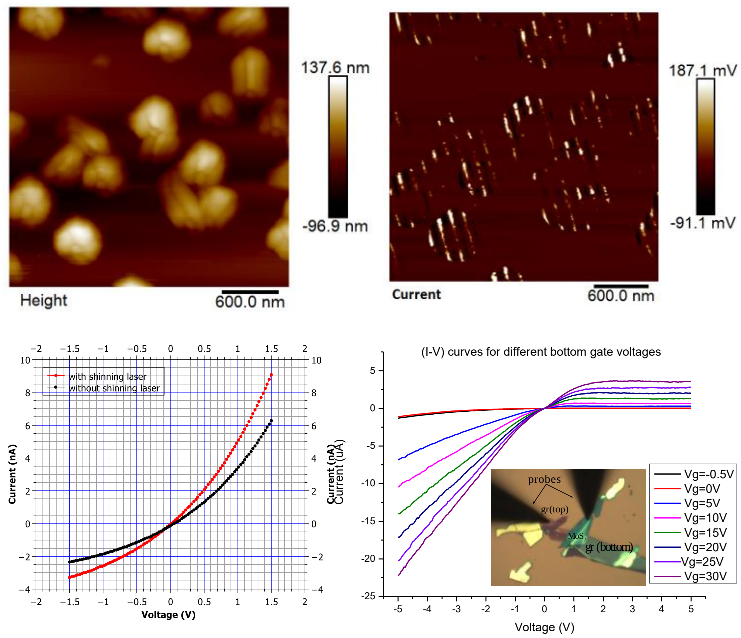


Fig. The top (left) shows topographic image on InAsNWs, top right image shows conductivity contrast, (I-V) curves performed by SSRM on InAsNWs, and bottom (right) image microscale measurements on heterostructures materials performed by PSM.

CONCLUSION

We have shown different methods to probe heterostructures in micro- and nanoscale regimes to investigate electrical properties which lead to assist in the development of electrical transport characterization methods and, of new electronic nanodevices. We plan to report measurement in 2D materials heterostructures and their photoresponse.

REFERENCES

1. K. S, Novoselov et. al, Science. 306, 666-669 (2004)

ACKNOWLEDGMENTS

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Abstracts selected for Oral and Poster Presentations in Advanced Nanomaterials (ANM) session

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