A UNIVERSAL SUBSTRATE FOR THE STUDY OF TWO-DIMENSIONAL MATERIALS

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The strong research focus that two-dimensional (2D) materials attract since the isolation of single layer graphene in 2004 is giving way to several applications and discovery of unique physical properties not observed in the 2D bulk counterparts [1]. Optical spectroscopy is one powerful tool for the study of these novel materials using SiO_2 on Si that is so far the substrate of choice. That substrate allows the visual inspection of 2D monolayers thanks to the interference of light that provides optical contrast and also enhancement of optical signals [2]. In this work we demonstrate that graphite, as a substrate, offers significant advantages with respect to the usual SiO_2/Si. The possibility to deposit any kind of 2D materials from multilayer, few layers, and monolayers, its chemical purity and stability, the high flatness, and the relatively strong interactions with the 2D materials due to van der Waals forces make graphite an excellent choice as an alternative substrate. We perform a systematic investigation with atomic force microscopy (AFM), photoluminescence and Raman spectroscopy of GaSe, MoS_2, and $ZnIn_2S_4$ deposited on several other substrates (SiO_2, indium tin oxide, and mica) and compare with the superb results obtained using graphite instead (including optical contrast). Moreover, due to the high electrical conductivity of graphite, we also achieved the electrical characterization at the nanoscale using Kelvin probe force microscopy. This work shows an alternative substrate with potential impact in the research of novel 2D materials.

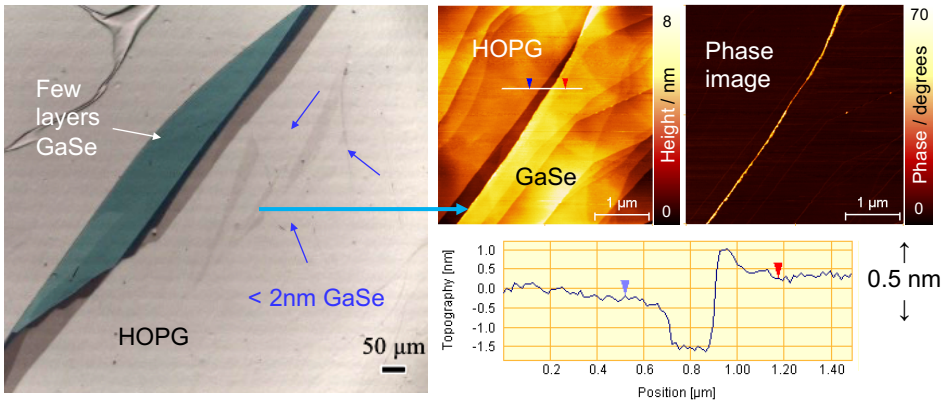

Figure 1: Graphite provides optical contrast in reflection of few layers and monolayers GaSe as dark gray regions. As observed by AFM the GaSe topography follows closely the HOPG. This is an indication of the relatively strong interaction with HOPG that allows deposition of few layers GaSe, that is not so easily accomplished on SiO_2

Keywords: Two-dimensional materials, Raman spectroscopy, photoluminescence, Kelvin probe force microscopy, graphite

References

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