ADVANCED ELECTRICAL NANO-CHARACTERIZATION OF 2-D MATERIALS WITH ATOMIC FORCE MICROCOPY

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Over the past 30 years, Atomic Force Microscopy has evolved from a microscope to measure just the surface topography to a wide variety of measurement modes that provides a way to characterize other atomic interactions or physical properties like magnetic field, electric field, nanoscale dissipation processes, thermal conductivity, electrical conductivity, resistance, surface potential, piezoresponse, Young modulus,… Electrical nanocharacterization with AFM has emerged as a powerful tool to map electrical properties at the nanoscale, like surface potential (work function) and conductivity. However, traditional setups in AFM make difficult to obtain accurate and repeteable results over several types of samples.

In this contribution we will show the capabilities new developed AFM modes: High Definition Kelvin Force Microscopy (HD-KFM), ResiScope, Soft-Resiscope and Scaning Microwave that overcome the intrinsic difficulties of electrical nanocharacterization with AFM. This techniques have been applied on a variety of 2-D materiales surfaces, like graphene or molibdene disulfide samples providing high stability, sensitivity and lateral resolution.

References

[1] 1.G. Binnig, C.F. Quate, Ch. Gerber, Phys. Rev. Lett., 56 (1986), 930
[2] 2.Houzé F, Meyer R, Schneegans O, Boyer L.. Appl Phys Lett., 69(1996)1975.
[3] 3.D.W. Abraham, et al, J. Vac. Sci. Technol. B 9 (1991)703
[4] 4.T.R. Albrecht, P. Gr¨utter, D. Horne, D. Rugar, J. Appl. Phys. ,69 (1991) 668
[5] M. Lanza, Conductive Atomic Force Microscopy: Applications in Nanomaterials, Wiley-, 2017

Figures

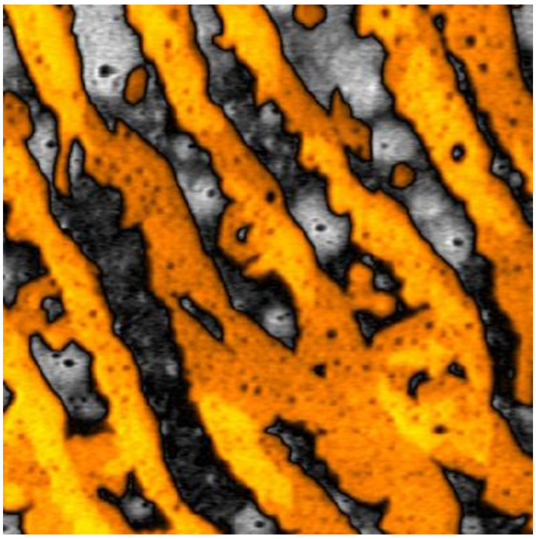

Figure 1: HD-KFM image of graphene on SiC sample. Gray areas correspond to SiC terraces, orange areas to 1ML graphene and yellow areas to 2ML graphene.

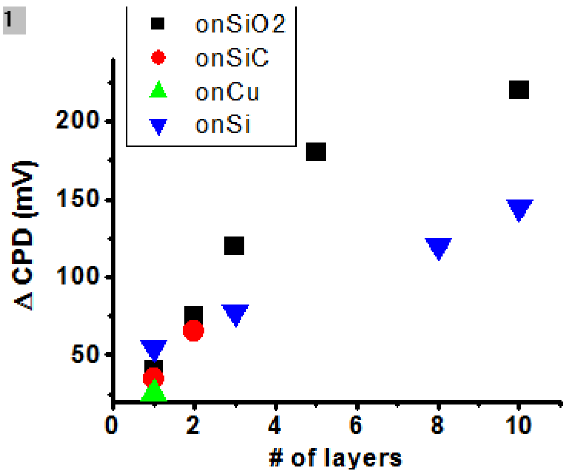

Figure 2: Surface potential difference of graphene monolayers on different substrates