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LEEM-PEEM microscopy: a tool for investigating the local and structural properties of Graphene at Nanoscale level

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The Graphene is nowadays one of the most promising materials for next generation electronic devices; its discovery was awarded by a Nobel Prize in 2010. The Graphene is a carbon bidimensional single crystal (single layer). The Graphene has attracted a much interest, strongly motivated by the fascinating and unique electronic and mass transport properties of the Graphene.

Up to now, two main elaboration methods have been employed to produce Graphene layers: micromechanical exfoliation of isolated Graphene from bulk graphite and epitaxial growth of Few Graphene Layers (FLG) deposited on top of silicon carbide substrate (SiC). Developing Graphene synthesis methods on silicon substrate, compatible with the silicon mass production industries, will enable to drastically reduce the production coast and make the Graphene more relevant for future nanoelctronics technologies. In this view, a collaborative team from the CNRS and SOLEIL has developed a new Graphene elaboration method (thin SiC layer on Silicon). We present here an original and new approach based on the use of a thin SiC epilayer deposited on Silicon wafers as pseudo-substrate, which allow overcoming the use of expensive SiC substrate.

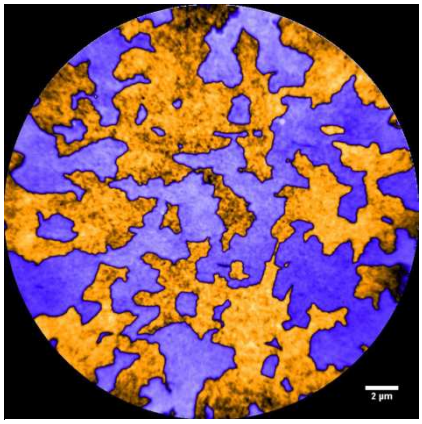

Figure: LEEM Image taken in Dark Field mode of Graphene layer on Si(100).

Moreover, the unique properties of the Graphene are known to be intimately linked to the local structure, electronic properties, and defects… at a nanoscale level. In this context, the combination of LEEM (Low Energy electron Microscopy) with PEEM (PhotoElectron Emission Microscopy) is a very powerful tool for studying the Graphene, as it will be discuss in this talk. The LEEM microscopy give access to the local morphology and structure, meanwhile the PEEM allow investigating the chemical (XPS) and electronic properties (ARPES), both with a resolution of few nanometer. Combining this mid-range microscopy with more established atomic scale microscopy as STM allow to give a clear description of the role played by the structure and the morphology on the electronic properties of Graphene layer.

[1] “Structural coherency of epitaxial graphene on 3C-SiC(111) epilayers on Si(111)”
A. Ouerghi, R. Belkhou, M. Marangolo, M. Silly, S. El Moussaoui, M. Eddrief, L. Largeau, M. Portail, and F. Sirotti, APPLIED PHYSICS LETTERS **97**, 1 (2010)
[2]“Epitaxial graphene on 3C-SiC(111) pseudosubstrate: Structural and electronic properties”
A. Ouerghi, M. Marangolo, R. Belkhou, S. El Moussaoui, M. G. Silly, M. Eddrief, L. Largeau, M. Portail, B. Fain, and F. Sirotti; PHYSICAL REVIEW **B** 82, 125445 (2010).