Growth parameters and functionalization of epitaxial graphene on silicon carbide

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Current trends indicate that graphene researches for applications related to electronics are split into two main routes. One route concerns mainly “organic electronics” in the broad acceptation, from transparent electrodes for photovoltaics, displays and touch screen to cheaper flexible electronics which could be introduced in the large dairy retailing markets. These technologies involve large areas of graphene sheets grown on various metal by chemical vapour deposition. On the other hand, epitaxial graphene grows on SiC can be produced as wafer-scale high quality material compatible with microelectronics technology [1]. However, at the moment the booming of this material is notably hampered by the low homogeneity of the number of layers; and the electronic roadmap mainly forecasts the use of such graphene for high-frequency logic applications [2]. Another critical step for application in electronic devices will be to open a gap. The optimization of SiC graphene growth and functionalization linked to its fundamental understanding are therefore on-going topics.

The studies presented in this poster are related to the optimization of growth of graphene on the Si face of 6H-SiC [3]. A comparative study of graphene growth under vacuum or in inert media at atmospheric pressure will be discussed. The surface reconstruction occurring during a specific step of annealing in presence of hydrogen at high temperature (>1500°C) along with a more controlled growth under Ar allowed to obtain better quality graphene in terms of homogeneity, surface roughness and domain size on large areas. A combined Raman-optical system study along with an AFM analysis revealed a sample with 2/3 of monolayer and 1/3 of bilayer or more with domains in the micrometer scales (Fig. 1a).
The device fabrication (Fig. 1b) and the chemical functionalization of the graphene substrate with compounds from the porphyrin families will be presented. The preliminary results on the chemical, structural and electrical properties of bare and modified graphene will be discussed.

References:

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Figure 1: a) AFM image of SiC graphene grown on Si face (annealed under H_2, growth at high T°C for 30 min under Ar); b) OM image of the graphene device geometry.