Spécialité de Master « Optique, Matière, Plasmas »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 4 /10 /2013

Responsable du stage / *internship supervisor*:

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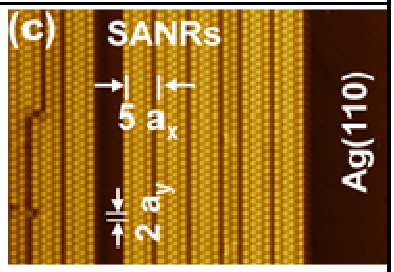
Lieu du stage / *internship place*: Tour 22 -12, 4e étage

Titre du stage / *internship title*: **Engineering silicene on passivated substrates**

Résumé / *summary*

Silicene is the silicon-based analogue of graphene, i.e. a 2-D honeycomb structure of silicon atoms. With specific electronic properties (large carrier mobility, opening of the energy gap...), it could pave the way for ultimate scaling and performance of future nanoelectronics devices. However, silicene does not exist in nature, and its elaboration requires specific substrates whose interaction with deposited silicon atoms is weak.



Recently, it has been claimed that deposition of silicon on a single crystal of silver could lead to formation of silicene, and the two recent years have shown a tremendous increase of research on silicene [1]. However, very recent articles indicated that a strong interaction between Ag and Si seems prevent this formation [see our paper: Bernard et al, Phys. Rev. B **88,** 121411(R), (2013), Figure on the right showing Si nanoribbons]

The main challenge is to elaborate silicene on a non reactive substrate. It has been proved theoretically that passivated silicon is a good candidate. Graphite, which is naturally not reactive, is another one. The project is to grow silicene on: (1) Si(111) surface, passivated by hydrogen; (2) on graphite surface.

Several techniques will be used for the elaboration and the characterization. The substrates will be prepared in an ultra-high vacuum chamber. The deposition will be done by molecular beam epitaxy, which permits us a very precise control of the Si deposits, on substrates with varying temperature.

The in-situ characterization will be done by:

- Scanning tunnelling microscopy (STM) and low energy electron diffraction (LEED) (determination of the honeycomb structure)

- Real-time surface-sensitive optical spectroscopy, during the growth (determination of the specific absorption of silicene) [see our paper : Coustel et al, Phys. Rev. Lett. 111, 096103 (2013)]

- Infrared spectroscopy (phonons of silicene)

Later on, additional studies will be done by X-ray diffraction and photoemission on synchrotron facilities and by Raman spectroscopy. Moreover, the experimental results will be compared to theoretical calculations performed in collaboration within the University.

These investigations should permit us to determine in a reliable way the actual existence of silicene and to determine its main properties

[1] Kara et al, A review on silicene: new candidate for electronics, Surf. Sci. Rep. 67 (2012) 1

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : Oui**

Si oui, financement de thèse envisagé/ *financial support for the PhD***: Ecole doctorale**

Lasers, Optique, Matière	**x**	Lumière, Matière : Mesures Extrêmes	**x**
Plasmas : de l'espace au laboratoire			

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