FROM MONOLAYER TO MULTILAYER SILICENE

J.-M. Layet, D. Beato-Medina, E. Salomon, G. Le Lay and T. Angot

Aix Marseille Univ, CNRS, PIIM, UMR 7345, Marseille, France

Silicene has attracted a huge interest since publication of the archetype 3×3 reconstructed monolayer phase on a silver (111) substrate in 2012 [1]. It is a synthetic emergent two-dimensional Si-based material that might rival graphene for logic applications in electronics [2] : indeed, the first monolayer silicene device, a Field Effect Transistor with ambipolar characteristics, has been fabricated in 2015 [3].

Ordered hydrogenation of 3×3 silicene has been achieved recently in Beijing [4], next in our Lab in Marseille, with further High Resolution Electron Energy Loss spectroscopy results [5].

Multilayer silicene has been also synthesized ; it possesses an intrinsic $\sqrt{3} \times \sqrt{3}$ surface reconstruction, hosts Dirac fermions, and is self-protected in ambient air by its native oxide [6,7]. However, despite such evidences, its mere existence has been severely questioned.

Here, we will show thanks to novel *in situ* Photoelectron Spectroscopy data as well as *ex situ* Surface X-Ray Diffraction and Raman spectroscopy results that multilayer silicene is effectively grown in a rather low temperature regime (~200°C), while, instead, diamond-type silicon terminated by the well-known Si(111)$\sqrt{3} \times \sqrt{3}$-Ag superstructure is formed at higher temperatures.

Keywords: Silicene; 2D Phases; Structural and Electronic Characterizations

References

[1] P. Vogt et al., Phys. Rev. Lett. **108,** 155501 (2012).
[2] G. Le Lay, Nature Nanotechnology **10,** 202 (2015).
[3] L. Tao et al., Nature Nanotechnol. **10,** (2015) 227
[4] J. Qui et al., Phys. Rev. Lett. **114,** 126101 (2015).
[5] E. Salomon et al., in preparation.
[6] P. De Padova et al., 2D Materials **1,** (2014) 021003.
[7] G. Le Lay, E. Salomon and T. Angot, Europhysics News, **47**, 17 (2016).