Sheet resistance of multi-layer stacking of silicene

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Abstract
During the year 2012, several groups have demonstrated that honeycomb lattices of silicon could be synthesized by epitaxial growth of silicon on the Ag(111) surface.[1,2,3] The observation of a conical band dispersion provided convincing evidences for the existence of a sheet of silicene with graphene-like properties.[1] Remarkably, the Fermi velocity measured from the photoemission data was found to be 1.3×10^6 m/s, slightly higher than in graphene. Such a result holds good promise to reach high electron mobility in silicene sheets, pleading for experimental studies of silicene transport properties.

Here, we will first describe the formation of silicene multilayers on top of an initial silicene layer grown on the Ag(111) substrate.[4] Based on Low Energy Electron Diffraction (LEED) and Scanning Tunneling Microscopy (STM) experiments, we will report on the LEED pattern and STM structure of the multilayers, that readily differ from the initial layer (Figure 1). The latter layer acts as a wetting layer, that enables the pilling up of the subsequent silicene layers into islands, consistent with a Stranski-Krastanov growth mode.

To perform transport measurements of the silicene sheets, we have then used a multiple probe STM combined with scanning electron microscopy. STM tips were positioned on micrometer-scale areas that were free of step bunches caused by the underlying Ag substrate and fully covered with islands of silicene multilayers. Since the contact formation between the probe and the silicene multilayers can modify the interlayer spacing and thus the electronic coupling of the multilayers with the Ag surface, an analysis of the conductance variation as a function of the tip displacement was performed. Based on this analysis, we will show that transport measurements can be acquired with a van der Pauw arrangement to determine the sheet resistance of silicene multilayers.

References

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Figures

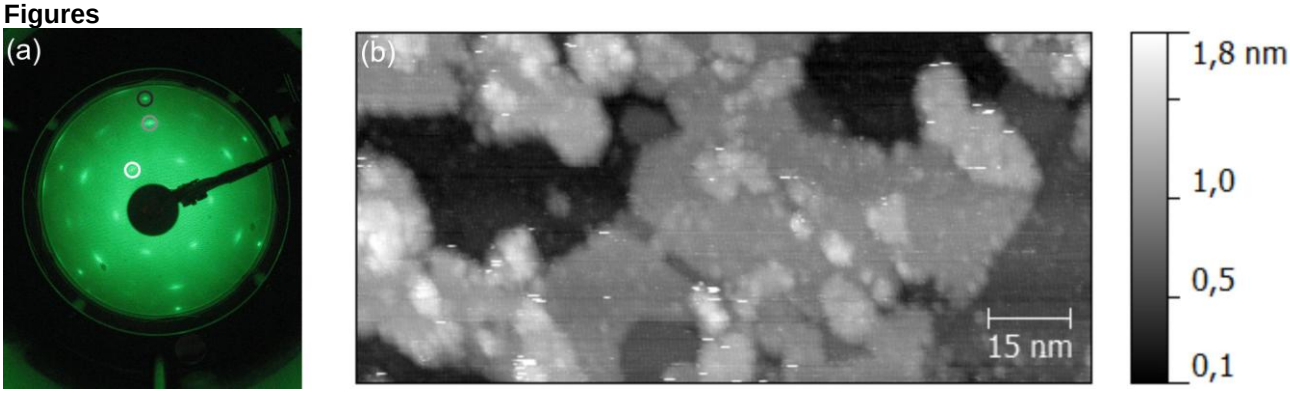

Figure 1. (a) the LEED pattern performed at 51eV, showing silver interger order spots, silicene integer order spots and (1/3,1/3) type superstructure spots of the (√3x√3)R30° silicene phase (from black to white).
(b) STM image with the silicene √3x√3 multi-layers recorded at 0.7V and 100pA.