Spin-orbit induced splitting in two-dimensional Dirac Cones in single and double antimony layers on Au(111).

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Since the discovery of graphene, two-dimensional (2D) Dirac Cones have attracted enormous attention [1]. Their linear dispersion and the vanishing of the effective mass are extremely appealing from both the fundamental and applied point of view [2]. Recently, it has been proposed that 2D Dirac states should appear in two-dimensional systems made of the group V element with phosphorene-like structure [3]. In these systems, Dirac Points are not located at high symmetry points in reciprocal space which makes them tunable in energy and wave vector by the application of strain. Such prediction has been recently verified for single antimony layers on SnS(001) substrate [4].

In our work we have explored a novel system, based on single and double antimony atomic layers on Au(111). By a careful choice of preparation conditions, the antimony layer assumes a structure similar to strained phosphorene as revealed by our scanning tunneling microscopy (STM) and X-ray photoemission spectroscopy (XPS) measurements. Via Angle resolved photoemission spectroscopy (ARPES) measurements we identify the presence of Dirac Cones located close to the edges of the Brillouin zone. These states, in contrast with previous reports, are also split in two sub-branches (see figure 1). Our Density Functional Theory (DFT) simulation identifies in spin-orbit interaction the origin of the splitting making this system unique among the 2D group V single-atomic layers.

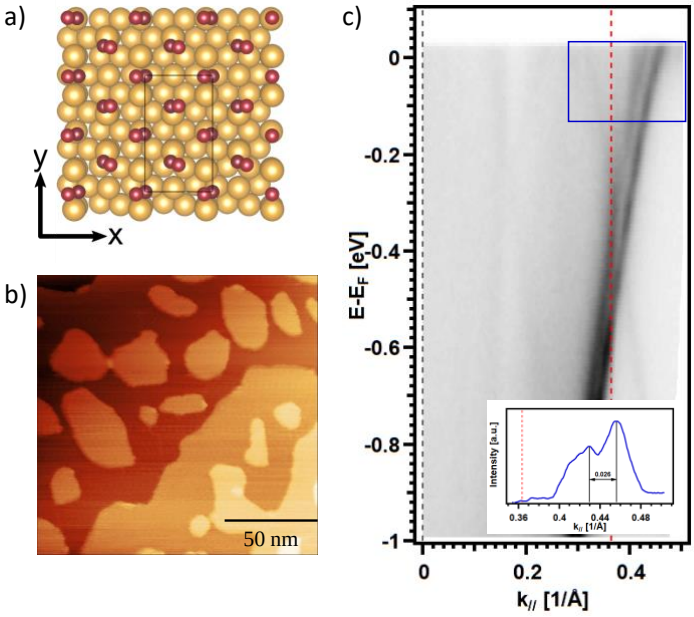

Figure 1: a) Schematic top view of the double layer antimony on Au(111) with phosporene-like structure. b) STM topography of Sb/Au(111) for SB deposition of 1.5 atomic layers. c) ARPES measurements of the double layer antimony on Au(111) showing split lineardispersive states. Inset: Momentum distribution curve at the Fermi level in the blue rectangle.

References

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