Superlattice of resonators on monolayer graphene created by intercalated gold nanoclusters

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Since the pioneering investigations on graphite formation on 6H-SiC(0001) and 6H-SiC(000-1) [1], the possibility to grow a few epitaxial layers of graphene on silicon carbide substrates, as demonstrated by C. Berger et al [2], appears to be a promising approach for practical electronic applications. The studies of electronic properties of epitaxial graphene reveal the existence of a n-type doping with a charge transfer from the substrate to the epitaxial graphene layer. In a recent report, a simple way to shift the Fermi level and induce p-type doping by deposition of gold atoms on top of graphene was proposed [3]. The authors proposed that gold atoms are covalently bonded to the epitaxial graphene.

However, in a deeper insight study by STM, we have revealed that gold atoms intercalate in between the buffer layer and the graphene monolayer. Depending on the preparation procedure we have obtained intercalated quasi “free standing” gold monolayer and small Au clusters [4].
We report here a detailed study of the intercalated “free standing” gold clusters. These clusters create on the upper monolayer graphene locally screened regions where quasi particles are perturbed as revealed by a strong standing waves pattern. This results in each cluster acting as a quantum dot creating a superlattice of resonators on graphene which has not been observed before. Furthermore a deeper insight of the standing waves pattern using Fourier Transform Scanning Tunneling Spectroscopy indicates strong localization at the Van Hove singularity corresponding to a band crossover and a nodal-antinodal dichotomy as observed for a “Van-Hove scenario” in the case of high Tc superconductors.

References

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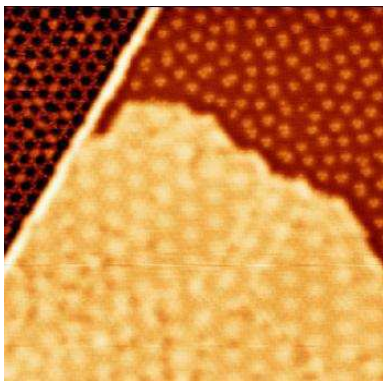
Figure



STM picture (40x40 nm², -1.0 V, 0.9 nA, 77 K) of the surface of epitaxial graphene obtained after gold deposition. It shows the pristine monolayer graphene and two new domains due to the intercalation of gold atoms between the monolayer graphene and the buffer layer. The first domain consists in the intercalation of gold clusters and the other one is formed by a freestanding monolayer of gold [4].