STM INVESTIGATIONS OF THE INTERACTION BETWEEN HYDROGEN ATOMS AND GRAPHENE ON DIFFERENT TRANSITION METALS

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The unique electronic properties of graphene make it an obvious substrate for molecular electronics. Adsorption of atomic hydrogen on graphene has been shown theoretically to open a substantial band gap [1]. Theoretical calculations of graphene with adsorbed lines of hydrogen atoms have demonstrated how the hydrogen lines can split the graphene sheet into ribbons with different electronic properties [2]. A periodic modulation of the graphene lattice can cause a band gap opening in the graphene [3]. However, the interaction between hydrogen and graphene, and its dependence on the substrate on which graphene is supported, remains poorly understood.

Here we present combined scanning tunneling microscopy (STM) measurements and density functional theory (DFT) calculations of graphene surfaces on different transition metals subsequently exposed to atomic hydrogen. There are remarkable differences in the results obtained for the different substrates. For graphene supported on Ir(111) the hydrogen atoms arrange in ordered patterns (Figure 1) [4], whereas on others there are no global order.

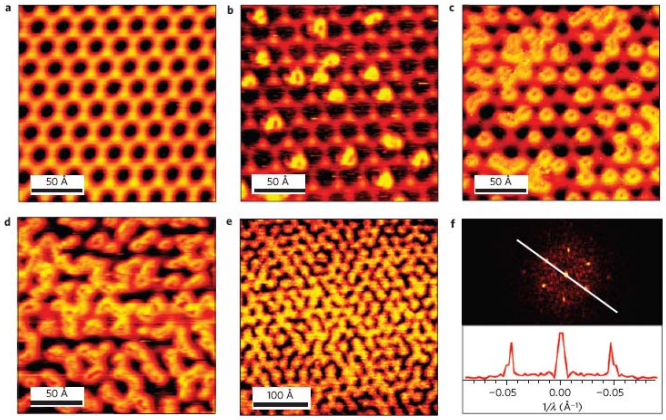

Figure 1

STM images of hydrogen adsorbate structures following demonstrating that Moiré pattern of graphene on Ir(111) is preserved.

a, Moiré pattern of clean graphene on Ir(111).

b–e, Graphene exposed to atomic hydrogen for very low doses of 15, 30 and 50 s respectively. The data show the evolution of hydrogen structures along the bright parts of the Moiré pattern with increasing hydrogen dose.

f, Fourier transform of the image in **e**, illustrating that hydrogen adsorbate structures preserve the Moiré periodicity. The inset in **f** shows a line profile through the Fourier transform along the line indicated. The separation of the peaks corresponds to a real-space distance of 21.5 Å, which is equal to 25 Å × cos(30°), confirming the Moiré superlattice periodicity.

References

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