Graphene growth on Pt(111) and Au(111) using a MBE carbon solid-source

1. Objective of work

There are multiple preparation methods of graphene reported. However, Molecular Beam Epitaxy (MBE) grow method provides a better control on growth time, chamber pressure and substrate temperature. This work will probe the efficiency for growing graphene on Pt(111) and Au(111) using MBE.

2. Sample description

Two tantalum bars connected through a glassy carbon filament in an Ultra High Vacuum (UHV) received a DC current of 14 A (110 W) to reach evaporation condition (2000 °C). The substrate, either Pt(111) or Au(111), were placed at 20 mm of the carbon source while were annealed at 650 °C and 550 °C respectively.
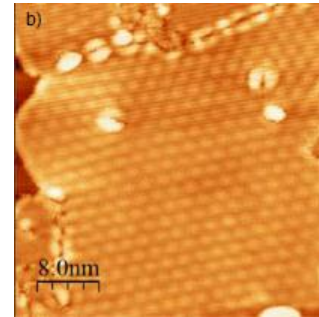
3. Equipment and conditions for scanning tunneling microscope

The measurement was performed at a base pressure of 1×10^{-10} mbar at room temperature. The STM images were obtained using an Omicron VT-STM operated with Nanotec's WSxM. The deposition rate of carbon on substrate was estimated around 3×10^{-4} ML/s.

Platinum (111)

STM picture showing graphene moirés separated by grain boundaries. Size= 65nm x 65nm, V=-35.7 mV, I=0.04 nA
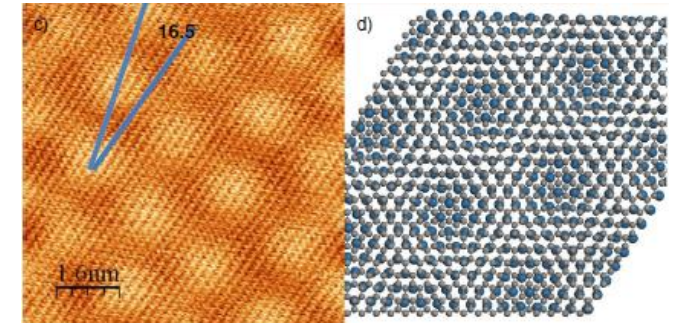
Atomic resolution image of graphene on platinum. The angle between the direction of moire bumps and atoms line is 16.5° Size 8 nm x 8 nm, V=-3507 mV, I= 0.04 nA

Gold (111)

STM picture showing dendritic patterns (darker) of graphene above of the gold. Size 350 nm x 350 nm, I=4 pA, V=-1241 mV.

STM picture in derivative mode showing graphene areas (red arrows) with several types of moirés. The gold herringbone is viewed on blue arrows. Size 67 nm x 67 nm, V= -107.8 mV, I=1 pA
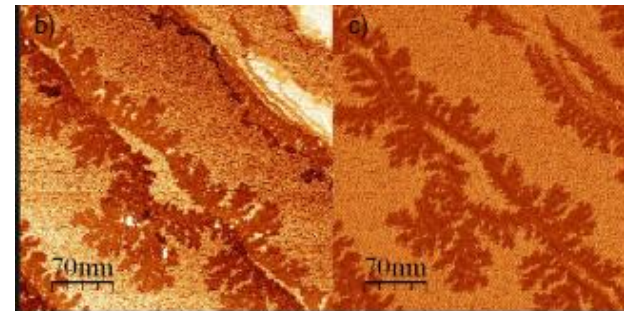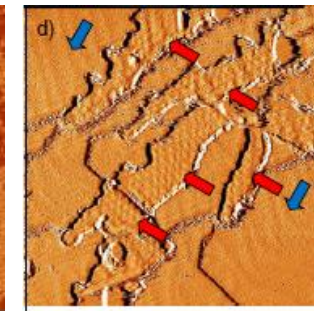
4. Results

Using STM technique, they concluded that the graphene layer was deposited about 50% of the Pt surface with 650°C. With respect of the gold substrate, the apparition of graphene on the surface is presented as dendritic islands. These islands are generated by the small electrical conductivity between graphene-gold or adsorbates on the STM tip. They tried to form graphene on Pt at 550 °C. However, it was formed an unordered carbonaceous growth.