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

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Graphene is considered a prototype material with interesting technological applications and properties [1]. Preparation methods greatly varies from mechanical exfoliation transfer [2] (widely used in research laboratories) to Chemical Vapor Deposition (CVD) [3] (more appropriate for industrial applications). When this latter method is used, the catalytic properties of the metallic substrate play a fundamental role in decomposition of hydrocarbons (cracking of C-H bonds).

In this work, we present a Molecular Beam Epitaxy (MBE) method to obtain graphene [4,5] on Pt(111). This procedure uses the evaporation of atoms from a carbon solid-source in ultra-high vacuum conditions. We have tested the formation of graphene on several surfaces: from a well established substrate as platinum, to substrates where graphene is usually formed using innovative methods, as gold [6]. For the characterization of the graphene layers, we have used several *in situ* surface science techniques as low-energy electron diffraction (LEED), Auger electron spectroscopy (AES), and scanning tunneling microscopy (STM).

The successful evaporation of carbon has been probed on different substrates, as platinum, HOPG, and gold. Our methodology presents an advantage with respect to others: graphene can be grown at low substrate temperature. By annealing a Pt(111) and Au(111) surfaces up to 600ºC and 450ºC respectively during carbon evaporation, we have observed a characteristic LEED pattern attributed to graphene [7]. STM images show long-range ordering of carbon monolayers (see figure). We observe different Moirés patterns characteristic of graphene on Pt(111) [8], and dendrite-islands on Au(111) [9], proving the formation of graphene. This method opens up new possibilities for the formation of graphene on arbitrary substrates with potential technological applications.

## References

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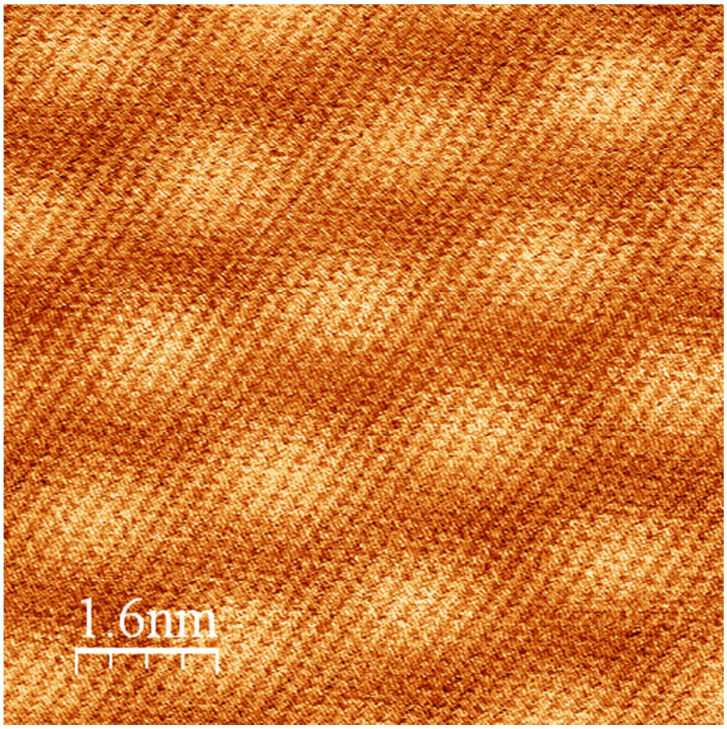


Figure 1: STM image of graphene on Pt(111) showing a long range moiré pattern and atomic resolution (Bias Voltage = -35.7mV, Current set-point = 0.04nA).

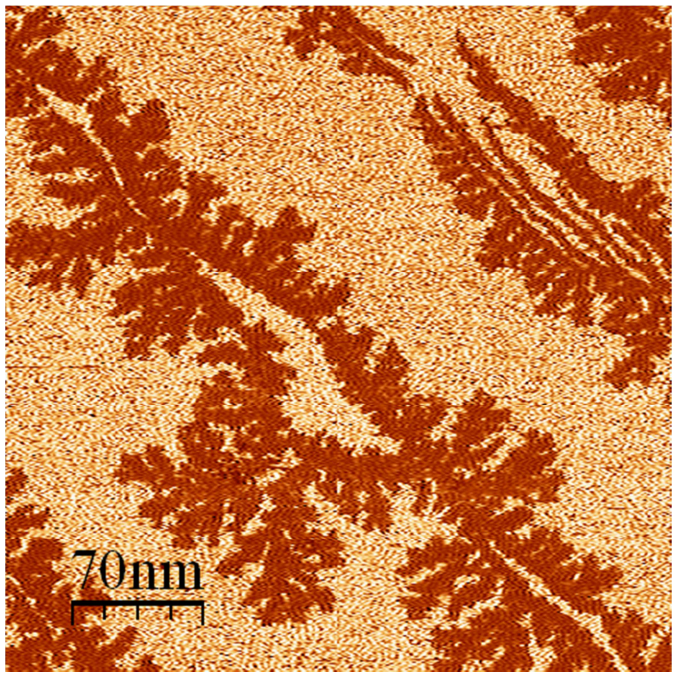


Figure 2: Current STM image of graphene on Au(111) showing long dendritic. Graphene appears as darker areas in this type of pictures (Bias Voltage = -1241.7mV, Current set-point = 0.04nA).