High-quality Graphene Growth on Platinum and Wafer-level Scale Graphene Transfer

KEN VERGUTS[1,2]
Lisanne Peters,[1,2] Cheng-Han Wu,[2] Cedric Huyghebaert,[2] Steven Brems[2] and Stefan De Gendt[1,2]

[1] *KU Leuven, Celestijnenlaan 200F, 3001 Leuven, Belgium*
[2] *imec vzw, Kapeldreef 75, 3001 Leuven, Belgium*

Ken.Verguts@imec.be

A CMOS compatible route to synthesize and transfer graphene is still missing. Chemical vapor deposition (CVD) is the main synthesis technique yielding high-quality wafer-scale graphene. Platinum is expected to be an excellent catalyst to grow monolayer, large scale and high-quality graphene. Moreover, electrochemical graphene transfer methods have been demonstrated, which facilitate the reusability of the expensive Pt template.
A process window is studied to grow graphene on platinum foils. The influence of growth temperature and time as well as the methane to hydrogen ratio is optimized. It is shown that the polycrystalline nature of the Pt foil makes it extremely difficult to grow a uniform monolayer graphene sheet. It is demonstrated that a Pt(111) thin film on sapphire decreases the amount of graphene nucleation centres and strongly reduces the graphene multilayer areas. The Pt(111) thin film appears ideally suited to grow millimeter-sized graphene islands in reasonable time frame (< 1 hour growth time).
To end, it is demonstrated that intercalation is of prime importance to promote graphene delamination from its growth template. STM measurements demonstrated for the first time the existence of interfacial water molecules between graphene and its CVD growth template.

Figures

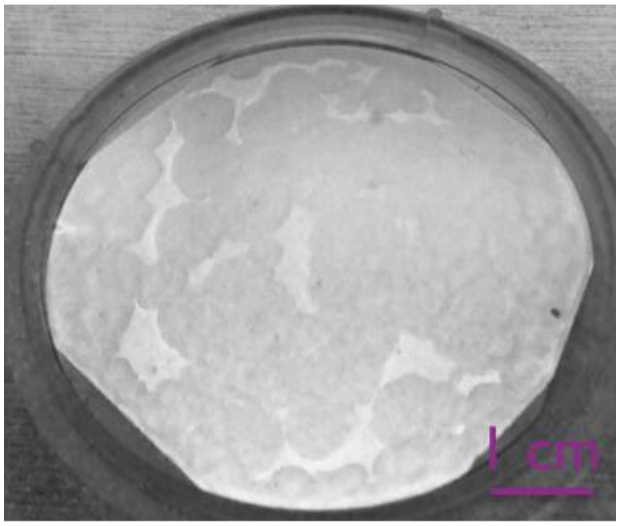

Figure 1: Graphene grown on Pt(111) via CVD. Graphene islands with diameters up to 7 mm are visualized by PMMA spin coating. Growth conditions: 1 h at 1080 °C with a CH_4:H_2 ratio of 6:850.

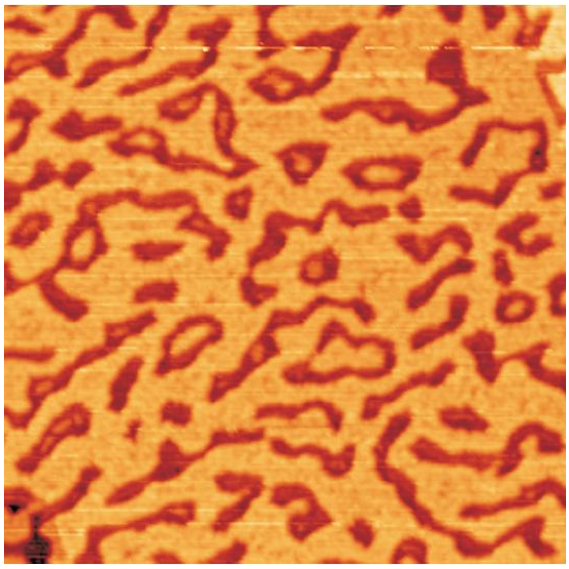

Figure 2: STM visualisation (184 nm x 184 nm) in UHV conditions of interfacial water areas (bright areas). The color scale is about 7 Å, which corresponds to two monolayers of H_2O.