Complementary in-situ XPS, XRD and E-SEM probing during graphene CVD on polycrystalline Cu

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Abstract

We systematically study the growth of graphene throughout the CVD process on commercially available polycrystalline Cu foils using a combination of complementary in-situ techniques: *in-situ* environmental scanning electron microscopy (ESEM), high-pressure time and depth resolved *in-situ* X-ray photoelectron spectroscopy (XPS) and *in-situ* X-ray diffraction (XRD) at realistic CVD conditions (~850-1000^{o}C and ~0.001 – 1mbar) for different hydrocarbon sources (CH_4, C_2H_4 and C_6H_6).[1,2]

Our time resolved *in-situ* experiments allow for a detailed study of the evolution of the catalyst's surface morphology and chemistry and the bulk crystallography. Most importantly changes in the Cu/graphene interaction are observed. This allows an accurate account of graphene growth to be developed and an improved understanding of the underlying growth mechanisms.

We find graphene CVD on Cu to be predominantly isothermal along with some precipitation, with kinetic effects also playing a role, similar to those observed for other transition metal catalysts: Ni.[3] We note this is unlike previously suggested simplistic growth mechanisms based on elemental solubility (C solubility in Cu) from ex-situ measurements. Finally, we highlight the importance of our in-situ approach to study the growth of other 2D nanostructures.

References

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