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In Situ Characterization of Alloy Catalysts for Low-Temperature Graphene Growth ROBERT WEATHERUP, BERNHARD BAYER, BRUNO DLUBAK, PIRAN KIDAMBI, Dept. Engineering, University of Cambridge, RAOUL BLUME, Helmholtz-Zentrum Berlin, CATERINA DUCATI, Dept. Materials Science and Metallurgy, University of Cambridge, CARSTEN BAEHTZ, Helmholtz-Zentrum Dresden-Rossendorf, ROBERT SCHLOEGL, Fritz Haber Institute, STEPHAN HOFMANN, Dept. Engineering, University of Cambridge — Chemical vapor deposition (CVD) on transition metal catalysts offers a low-cost method of producing large-area graphene, but due to limited understanding of the underlying mechanism(s), growth control remains rudimentary. We use in situ X-ray photoelectron spectroscopy (XPS) and X-ray diffraction (XRD) to monitor catalytic CVD on Ni based catalysts under typical reactor conditions. We thus develop a coherent model for graphene formation and show that graphene growth occurs during isothermal hydrocarbon exposure and is not limited to precipitation upon cooling. We introduce alloy catalysts to improve graphene growth by tuning reactivity and selectivity. We show that alloying polycrystalline Ni with Au allows low temperature ($<450^\circ$C) CVD of predominantly monolayer ($>74\%$) graphene films with an average D/G peak ratio of $\sim$0.24 and domain sizes in excess of 220μm^2 [1]. We suggest that Au decorates a majority of high reactivity Ni surface sites, such as step edges, and lowers the stability of surface C. Au alloying thereby drastically lowers the graphene nucleation density, allowing more uniform and controlled growth at CMOS compatible temperatures. [1] Weatherup et al. Nano Lett. 11, 4154 (2011)

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