Effect of deposition parameters for fast graphene growth using a cold wall CVD reactor

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Abstract:

In this work we investigate the effect of growth parameters to obtain fast growth of high quality monolayer Graphene using a commercially available 4-inch cold wall CVD system (Aixtron black magic Pro CVD reactor). A copper foil was used as a catalyst for the growth. The role of growth parameters including temperature, chamber pressure, annealing time and hydrogen/methane ratio has been investigated. Raman spectroscopy mapping and scanning electron microscopy were used to analyse the quality and the homogeneity of graphene.

Our results show that for a fixed chamber pressure at 25mbar, increasing the growth temperature results in reducing the nucleation density. As shown in figure 1, at 1060°C, the density of multilayer graphene was reduced by more than 50% compared to growth temperature of 1000°C.

As demonstrated in figure 2, by reducing the chamber pressure from 25mbar to 15mbar at fixed temperature of 1060°C, a monolayer graphene was obtained with grain size of <1μm. By further reduction in chamber pressure to 5mbar, the graphene grain size has increased to approximately 5μm.

The effect of annealing time as well as hydrogen to methane ratio are further investigated. Finally, this study provides an insight into understanding the effect of growth parameters toward achieving fast growth of high quality monolayer graphene in cold wall CVD reactors.

Figures

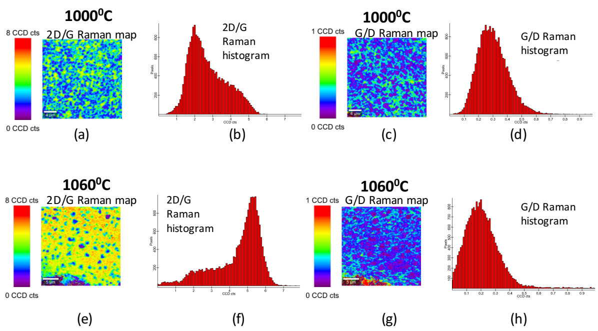

Figure 1: Map of 2D/G intensity ratio at (a)1000°C and (e) 1060°C, (b) histogram of 2D/G intensity ratio at (b)1000°C and (f) 1060°C, Map G/D intensity ratio at (c)1000°C and (g) 1060°C, histogram of G/D intensity ratio at (d)1000°C and (h) 1060°C

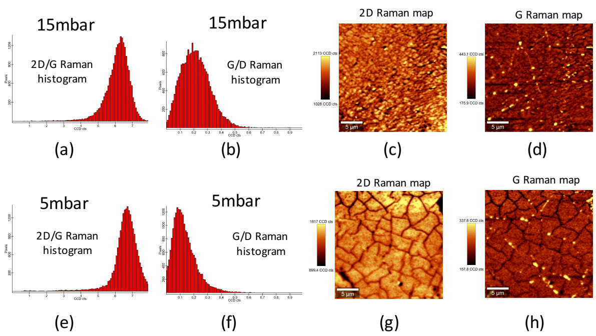

Figure 2: Histogram of 2D/G intensity ratio at (a) 15mbar and (e) 5mbar, Histogram of D/G intensity ratio at (b) 15mbar and (f) 5mbar, Map of 2D intensity (c)15mbar and (g) 5mbar, Map of G intensity (d)15mbar and (f) 5mbar,