Imaging techniques for characterizing the nucleation dynamics in CVD graphene

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Graphene grown by chemical vapor deposition (CVD), although requiring transfer to arbitrary substrates [1], has succeeded in fields such as energy [2,3] or optoelectronics [4,5]. From all type of CVD systems, commercially available cold-wall reactors (Fig. 1) have proven to be industrially-scalable and fast. However, polycrystalline material is typically obtained, where the density and size of the coalesced graphene single crystals are key parameters for assessing its quality, as grain boundaries are known to affect its performance [6]. In this work, we present an algorithm based on ImageJ suite and a neural-network classifier [7] for addressing the nucleation dynamics in terms of the nucleation density and the growth speed (Fig. 2). With this new information, a deeper understanding of the growth mechanisms can be attained to improve the quality of the CVD material.

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References

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Figures

Figure 1: Cold-wall CVD reactor Aixtron BM Pro. In a typical growth, 4-inch graphene samples are grown in less than 2 hours.

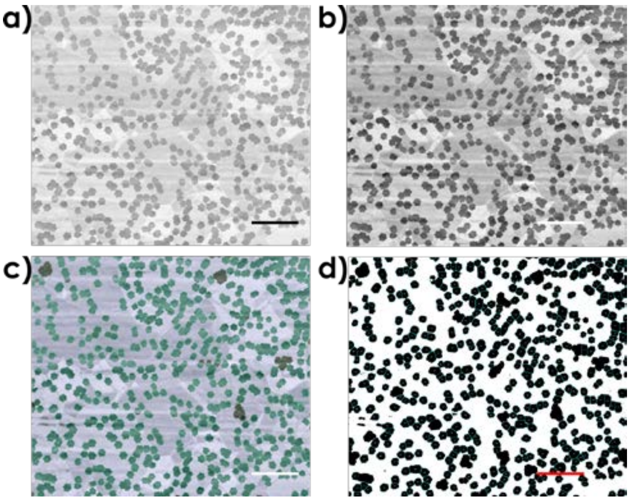

Figure 2: As-grown graphene on top of oxidized Cu foil catalyst. Image processing for obtaining graphene crystallinity information:
a) SEM initial image.
b) Filtered and contrast-enhanced image.
c) Classified image (graphene/background).
d) Grain count and area measurement.
100 µm scale bar in all images.