Kinetic studies of few-layer graphene grown by flame deposition from the perspective of gas composition and temperature

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Abstract

Studies on depositions of chemical vapour deposition (CVD) diamond films have shown that flame combustion has the highest deposition rates without involving microwave plasma and direct current arc. Thus, here we report on our study of few-layer graphene grown by flame deposition. A horizontal CVD reactor was modified for the synthesis of flame deposition of few-layer graphene on a Cu substrate. It was found that graphene obtained has comparable quality to that obtained with other flame deposition setups reported in the literature as determined from Raman spectroscopy, sheet resistance, and transmission electron microscopy. Calculation of the chemical kinetics reveals a gas phase species that has a close correlation to the growth rate of graphene. This was further correlated with van't Hoff analysis of the reaction, which shows that the growth reaction has a single dominating mechanism for temperatures in the range of 400 degrees C to 1000 degrees C. Arrhenius analysis also was found to be in good agreement with this result. This study shows few-layer graphene growth proceeds through different pathways from a CVD grown graphene and also highlights flame deposition as a viable method for graphene growth.

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