High-quality graphene growth via roll-to-roll chemical vapor deposition

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The investigation on a high throughput manufacturing process is urgently needed in order to enable the mass production of graphene. The roll-to-roll (R2R) production technique has emerged as an economically viable solution since it is easier to automate and more compatible with the subsequent transfer process [1]. So far, the research on R2R process has mainly focused on the reactor design or the loading configuration, and there severely lacks an in-depth understanding of its growth kinetics. In this work, the evolution of graphene growth is comprehensively investigated. In the conventional batch-to-batch (B2B) process, there was no carbon precursor in the heating-up stage [2-3]. In contrast, the substrate was heated up in the early-established reaction atmosphere, and graphene could nucleate and grow at a lower temperature in the R2R process. The graphene domain density grown via the R2R process was apparently larger than that by the B2B process due to different reaction profile. Moreover, the defective graphene could be healed with an elongated reaction time. With our optimized R2R process, graphene film with the quality comparable to that grown by the B2B process could be achieved. Our research will greatly promote the development of the mass-production technique of graphene film.

REFERENCES

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FIGURES

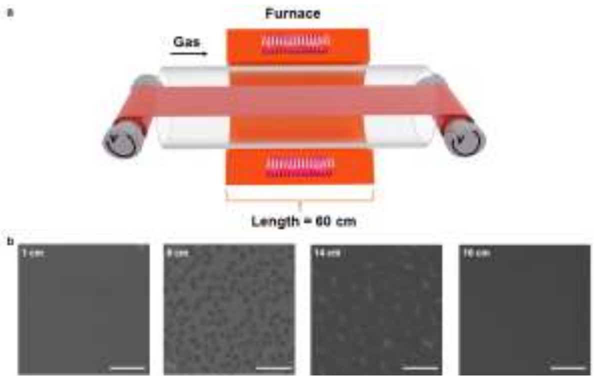

Figure 1: (a) Schematic of the R2R CVD equipment. (b) SEM images of the grown graphene on Cu with a motion speed of 3.5 mm/min and 100 sccm CH_4/Ar. Scale bar is 1 μm. The labels indicates sample positions.

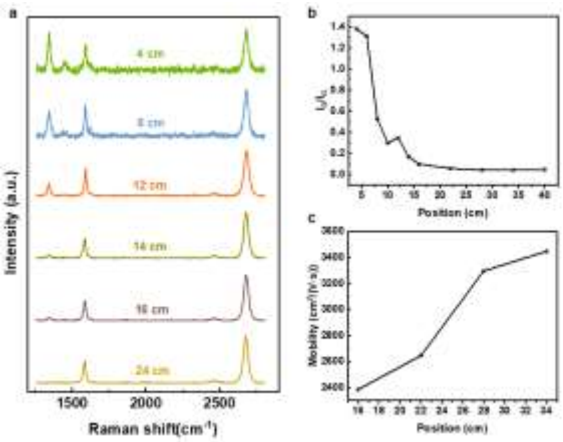

Figure 2: (a) Raman spectra of graphene from different positions with 100 sccm CH_4/Ar. (b) I_D/I_G and (c) the normalized carrier mobilities at the carrier density of 1×10^{12} cm^{-2} v.s. position, respectively.