New Approach to achieve Transfer-Free TCVD Growth of graphene on Semiconductors at low temperatures

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The growth of graphene at low temperature has been an outstanding goal for the community to avoid the drawbacks of the transfer process and directly grow in semiconductors that maybe affected by the high temperature growth. Here, we introduce a new growth method to directly grow graphene on semiconductor substrates at low temperatures by means of conventional chemical vapor deposition (CVD) including Germanium (Ge) and Gallium arsenide (GaAs). This was done by designing a multizone furnace CVD system with thermal variation along the horizontal line of the CVD chamber. The high temperature zone was used to dissociate the gaseous carbon precursors while the semiconductor substrate was placed in the low temperature zone. The heat distribution across the CVD chamber was demonstrated using a computational fluid dynamics (CFD) model, and the temperature of each heating zone was calibrated according. The chamber pressure and Argon flow were investigated as key factors in determining the quality of the graphene film. As a result, a uniform graphene film with the Raman ratio ID/IG ≈ 1.01 was obtained on Ge surface indicating the presence of multilayer graphene. Furthermore, a technique of self-limiting growth mechanisms was proposed to optimize the graphene layer growth on GaAs. In this work we have made the first demonstration of TCVD growth of graphene directly on semiconductors, specifically GaAs, without functionalization of the substrates. This paves the way for next-generation carbon-based atomic electronics and semiconductor nano-devices.

References

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Figures

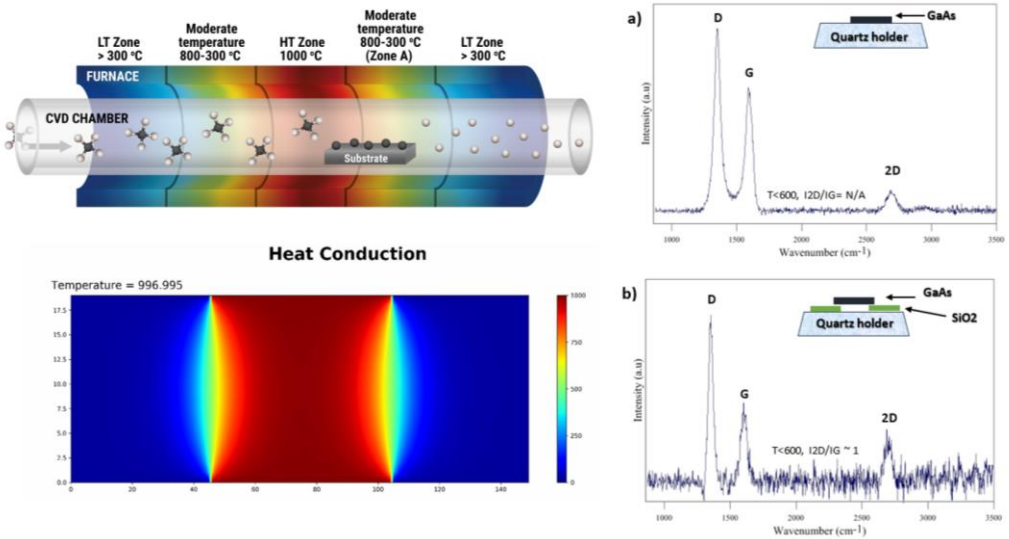

Figure 1: Multizone CVD system with gradient temperature control for low-temperature growth of graphene.