CVD graphene growth on reusable catalytic substrates for biomedical applications

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Abstract

Because of the graphene electrical and electrochemical performance and its suitability for integration into flexible devices, graphene-based materials constitute a versatile platform that could be used for biomedical applications. The importance of reproducible, high-quality, and large-area graphene growth lies in the need of maintaining the defined graphene structure to profit from its properties. For graphene-based technologies in the biomedical field, Chemical Vapor Deposition (CVD) has evolved to a scalable and reliable synthesis method, standing out as the most promising alternative. In the academic research, graphene is currently grown on flexible Cu foils. However, low reproducibility of the foils (in terms of roughness and grain boundaries), as well as the challenge in achieving the desired Cu crystal orientation, has necessitated exploring alternative substrates for material growth. [1][2] In this work, we propose the deposition of Cu onto sapphire substrates, obtaining rigid thin film Cu as the catalyst substrate. This alternative not only overcomes the currently disadvantages of using Cu foils, but also enables the reusability of such substrates. Here, we evaluate the impact of several procedures parameters, such as temperature (T), pressure (P), growth time and gas flow, to optimize the production of high-quality, large-scale graphene. The quality and the roughness of the grown material have been evaluated using Raman spectroscopy and Atomic Force Microscopy (AFM), respectively. The reusability tests of the rigid substrates have revealed that the sapphire terrace surface is maintained after the chemical etching procedures (included in the transfer process) enabling the possibility of reusing sapphire. Moreover, we compared the standard graphene with the rigid one in terms of electrical performance of the fabricated devices. Finally, this CVD growth strategy opens the door to replacing PMMA in the transfer process with protection layers, thus avoiding residual contaminants coming from polymers and achieving cleaner transferred graphene.

References

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