Graphene Solar Cells fabricated with an Automated Graphene Transfer System

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Abstract: Although graphene grown by chemical vapor deposition (CVD) has proven to be an excellent material for electronic applications, an inconvenience of this method is the need of transferring the thin graphene layer from the initial metal catalyst to a suitable final substrate. A manual transfer method [1] was developed in order to overcome this issue. It consists of protecting the graphene with a polymer layer, wet-etching the growth substrate, cleaning with deionized water and finally depositing the resulting polymer/graphene membrane onto the desired target substrate. Some drawbacks of this method are that it requires handling skills to perform it, that it is time consuming, and that it is not suitable for an industrial process. An optimized method based on a roll-to-roll system [2] can overcome some of the manual method limitations, but it is mainly focused on flexible, transparent electrodes applications, hence its use for laboratory scale is not convenient due to the initial high investment needed, the typical sample size used or the limitation to flexible substrates.

We report a lab-scale system designed to automatically transfer graphene to arbitrary substrates, but we adapted it for industrial applications like solar cells. The system is composed of several modules that control the process temperature, the liquid flow and the overall system state. A microcontroller is used as the real-time control. The passive components of the system are depicted in Fig. 1. A PTFE tube encloses the graphene sample during the whole process. This enclosing tube has a surface treatment that centers the polymer/graphene membrane that floats inside it. The treatment avoids mechanical stress or induced ripples in the graphene during the process. A fixed platform and a substrate holder ensure a fixed position between the final solar cell and the tube center. All this pieces are immersed in a liquid, starting with an etchant solution and changing gradually into deionized water for the final steps. Finally, graphene solar cells were processed using a manual method and our automatic method for comparison, showing higher mobilities and less charge impurities for the latter one.

References

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Figures

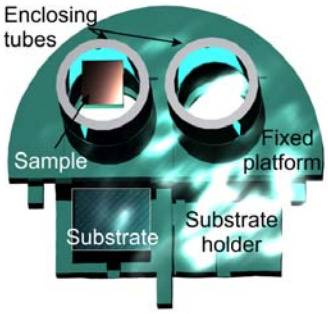

Figure 1 — Automated transfer system