**Modified Langmuir-Schaefer method for large-scale deposition of graphene oxide layers in polymer solar cell research**

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## Abstract

The graphene oxide (GO) stays in forefront of promising materials as an interfacial layer in polymer solar cells[1]. The conventional hole transport layer (HTL) based on PEDOT:PSS thin films is prone to fast degradation. Recently, spin-coated GO thin films have been proposed to replace the PEDOT:PSS material as HTL [2-4]. It was demonstrated that further oxidation of GO thin film by means of UV/ozone treatment increases the device efficiency by 15% compared to the conventional PEDOT:PSS HTL[5]. Moreover, the interface layer based on GO will reduce interdiffusion between the active layer and the conductive ITO (tin-doped indium oxide) layer. Here we demonstrate application of a modified Langmuir-Schaefer method to facilitate a controlled large-area homogenous deposition of GO thin films onto arbitrary substrates. The GO was synthesized by a modified Hummers method and further purified by centrifugation in order to select only single layer GO flakes. The final GO material was redispersed in methanol/water solution and applied onto the water surface. The GO Langmuir film prepared at the surface pressure of 15 mN/m was transferred onto ITO coated glass by a controlled removal of the water subphase. The Fig. 1a shows scanning electron microscopy image of GO deposited layer. The Fig. 1b shows its atomic force microscopy image along with a line cross-section. The first set of as-deposited GO films was further reduced at different temperatures up to 400°C in a high vacuum chamber. The second set of the as-deposited GO films was oxidized by UV/ozone treatment. The reduction/oxidation effect on the GO electron structure was monitored by electrochemical impedance spectroscopy and Kelvin probe method. As the next step, the reduced/oxidized samples were embedded into a standard polymer solar cell with the structure Glass/ITO/(r)GO/P3HT:PCBM/Ca/Ag in order to inspect the impact of GO oxidization/reduction on particular parameters of I-V curves such as fill factor, open-circuit voltage, short-circuit current and solar cell efficiency in the end.

## References

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## Figures

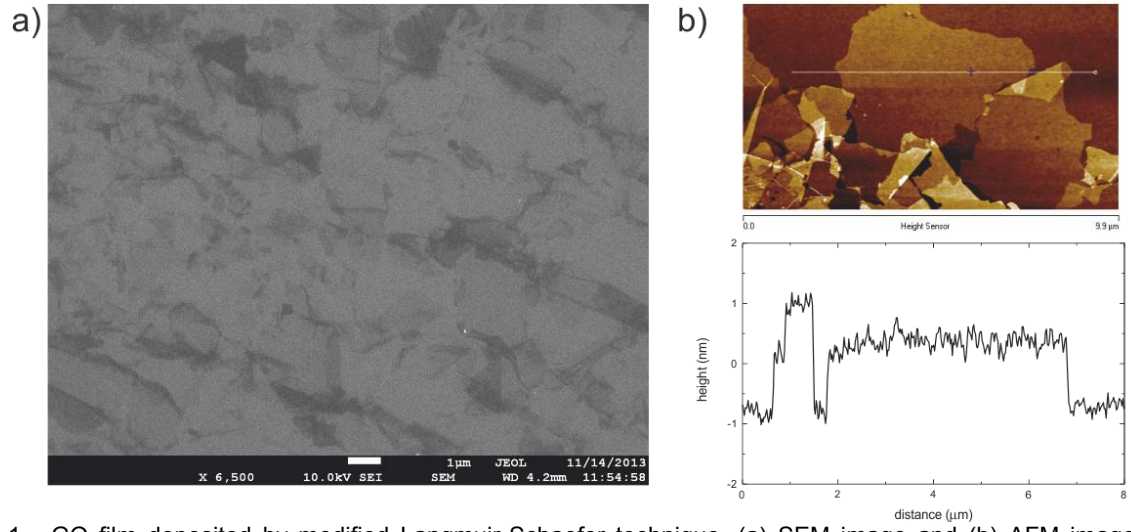


Fig. 1 - GO film deposited by modified Langmuir-Schaefer technique. (a) SEM image and (b) AFM image with corresponding line scan.