Electronic Supplementary Material (ESI) for Nanoscale

Graphene-Platinum Nanohybrid as a Robust and Low-cost Counter Electrode for Dye-sensitized Solar Cells

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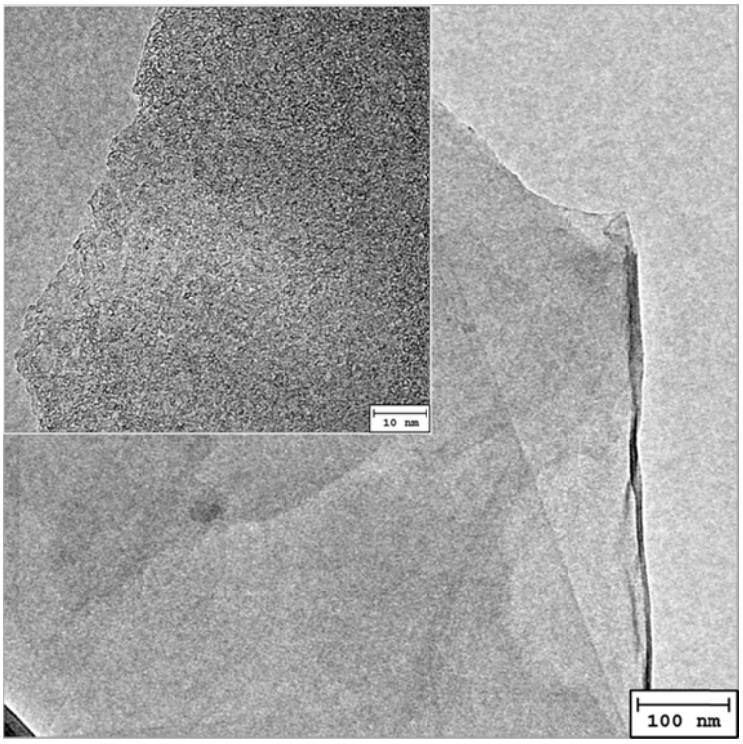

Figure S1. TEM and HRTEM (insert) images of graphene oxide sheets

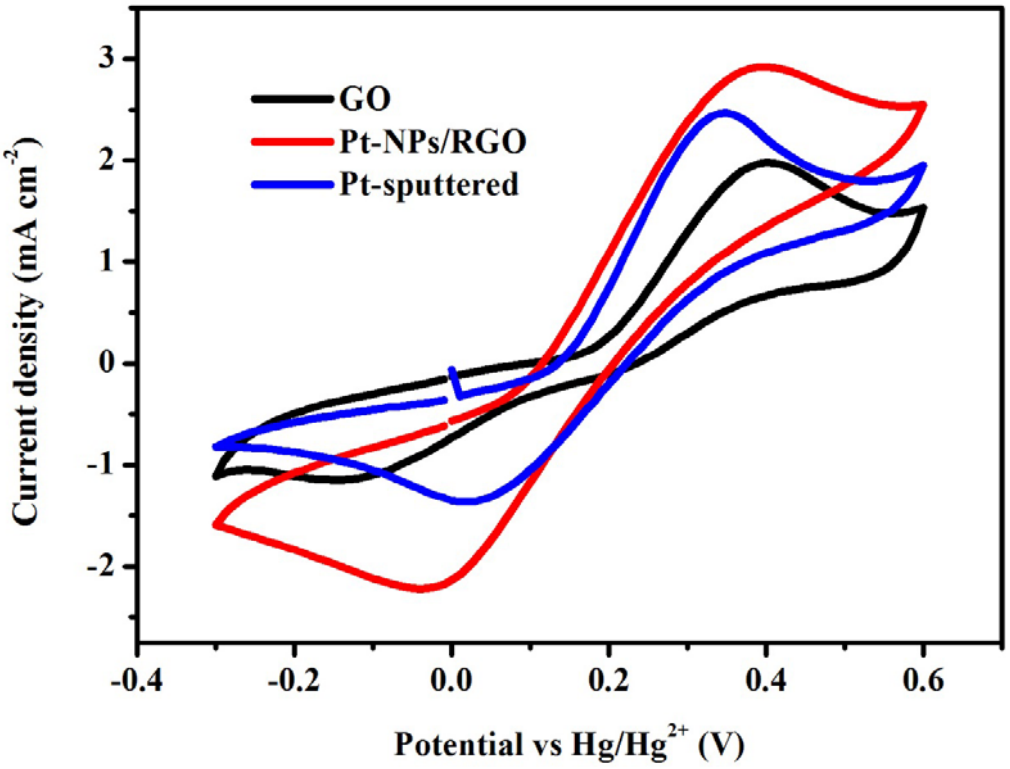

Figure S2. Cyclic voltammograms of a GO electrode, Pt-sputtered electrode and Pt-NPs/RGO nanohybrid electrode

The catalytic performance of a GO electrode, Pt-sputtered electrode and Pt-NPs/RGO nanohybrid electrode was evaluated through comparative analysis of their cyclic voltammograms (CV) in 5 mM LiI + I_2 acetonitrile solution containing 0.1 M $LiClO_4$ as the supporting electrolyte [S1]. The electrochemical cells in the three electrode configurations were used. The Pt mesh was used as a CE, and Hg/Hg^{2+} served as a reference electrode. The data were recorded in the potential range of 600 mV to -300 mV with a scan rate of 50 mV s^{-1} [S1]. As can be seen in Figure S2, the Pt-NPs/RGO nanohybrid electrode exhibits a higher current density, which can be estimated from the large peak area in the CV curve, suggesting a larger electrode active surface [S1,S2]. While the reduction reaction of triiodide ions at the GO electrode is really slow, the Pt-NPs/RGO nanohybrid electrode shows the highest cathodic peak, which means that it has high electro-catalytic activity. This high electro-catalytic activity can reduce the charge transfer resistance at the CE/electrolyte interface. It not only reduces internal resistances, but also attenuates the recombination rates and concentration gradients in the electrolyte, which have been proved to strongly affect J_{sc} [S3].

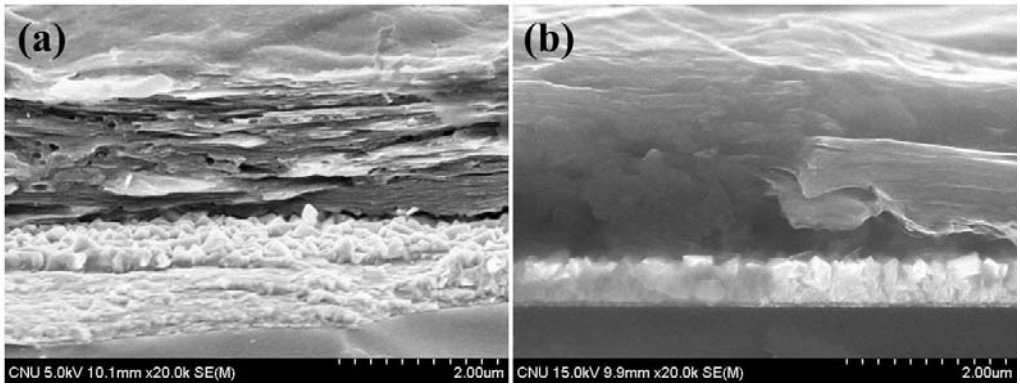

Figure S3. SEM images of electrode films on FTO glass substrate (cross-section), showing the thickness of the films. a) GO-coated electrode, b) Pt-NPs/RGO nanohybrid-coated electrode.

Table S1. Sheet resistance of counter electrodes

Counter electrode	Rs (Ω/sq)
GO-coated	6.412 ± 0.028
Pt-NPs/RGO-coated	6.326 ± 0.018
Pt-sputtered	1.333 ± 0.011

References

[S1] V. D. Dao, S. H. Kim, H. S. Choi, J. H. Kim, H. O. Park, J. K. Lee, *J. Phys. Chem. C* 2011, **115**, 25529.

[S2] G.-R. Li, F. Wang, Q.-W. Jiang, X.-P. Gao, P.-W. Shen, *Angew. Chem., Int. Ed.*, 2010, **122**, 3735.

[S3] Z. Tachan, M. Shalom, I. Hod, S. Ruhle, S. Tirosh, A. Zaban, *J. Phys. Chem. C* 2011, **115**, 6162-6166.