Electronic Supplementary Information

Polyethyleneimine-assisted synthesis of high-quality platinum/graphene hybrids: The effect of molecular weight on electrochemical property

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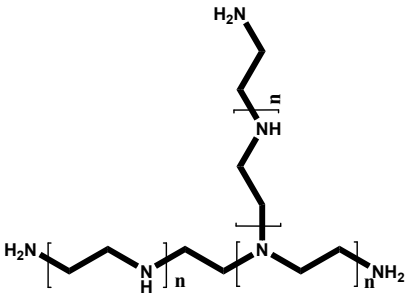
‡ These two authors made an equal contribution to this work.



Scheme S1. The molecular structure of PEI.

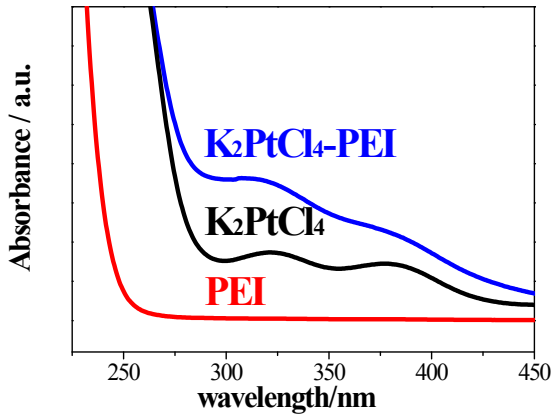


Fig. S1 UV–vis absorption spectra of (a) PEI solution (pH 10.5), (b) K_2PtCl_4 solution (pH 10.5), and (c) the mixture solution of PEI and K_2PtCl_4 (pH 10.5, molar ratio of PEI monomer to K_2PtCl_4 is 10:1).

The UV–vis absorption spectroscopic measurements confirm the interaction between PEI and PEI K_2PtCl_4. Upon addition of the PEI solution (pH 10.5) to the K_2PtCl_4 solution (pH 10.5), the characteristic absorption peaks at 320 and 377 nm for the K_2PtCl_4 species exhibit a blue-shift, demonstrating that PEI interacts with K_2PtCl_4 via coordination interactions, and generates the PEI–Pt^{II} complex. Since Pt^{II} species generally generate the $[Pt^{II}(NH_3)_4]^{2-}$-like structure four coordination compounds, the obtained PEI-Pt^{II} complex under the present experimental conditions contains the un-coordinated $–NH_2$ groups due to high molar ratio of PEI monomer to K_2PtCl_4 (10:1).

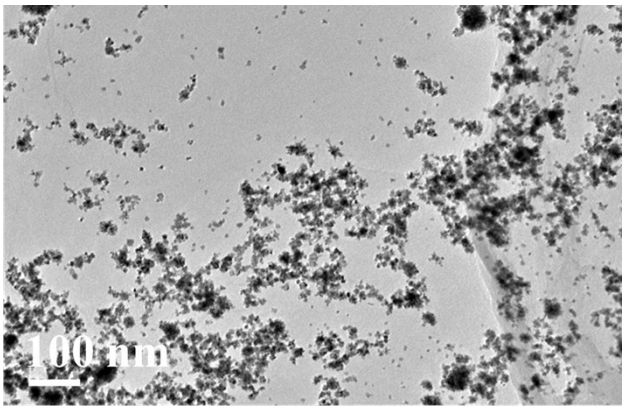


Fig. S2 TEM image of Pt/RGO hybrids that synthesized in the absence of PEI

Preparation of the Pt/RGO hybrid without PEI: 0.8 mL of 0.05 M K_2PtCl_4 and 40 mL of homogeneous GO suspension (0.25 mg mL^{-1}) stirred for 30 min. Subsequently, 10 mL of 0.125 M $NaBH_4$ solution was slowly added into the mixture with stirring for 2 h. Finally, the Pt/RGO hybrid was collected by centrifugation at 1200 rpm for 15 min, washed eight times with water.

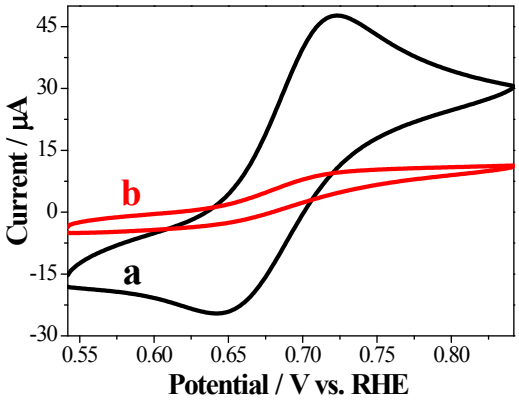


Fig. S3 Cyclic voltammograms of (a) the RGO-600 and (b) RGO-10000 hybrids in N_2-saturated 0.5 M H_2SO_4 solution containing 0.5 mM hydroquinone at a scan rate of 50 mV s^{-1}.

Preparation of the RGO-600 and RGO-10000 hybrids: Firstly, 0.8 mL of 0.5 M PEI solutions and 40 mL of homogeneous GO suspension (0.25 mg mL^{-1}) were mixed and stirred for 30 min. Then, 10 mL of 0.125 M $NaBH_4$ solution was slowly added into the mixture with stirring for 2 h. Finally, the RGO-PEI hybrids were collected by

centrifugation at 1200 rpm for 15 min, washed eight times with water, and then dried at 40 °C for 24 h in a vacuum dryer. When low molecular weight PEI (Mw 600) and high molecular weight PEI (Mw 10000) were used as reaction precursors, the resultant RGO hybrids were named as the RGO-600 and RGO-10000 hybrids, respectively.

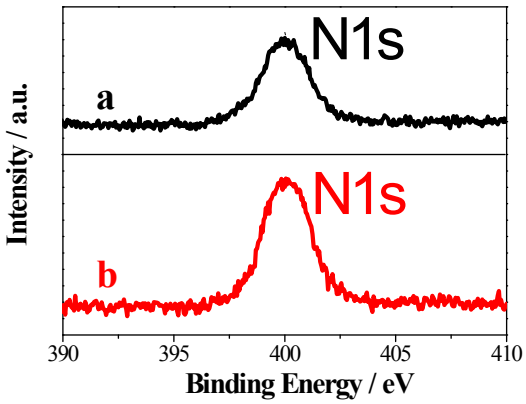


Fig. S4 N1s XPS spectra of the (a) Pt/RGO-600 and (b) Pt/RGO-10000 hybrids.

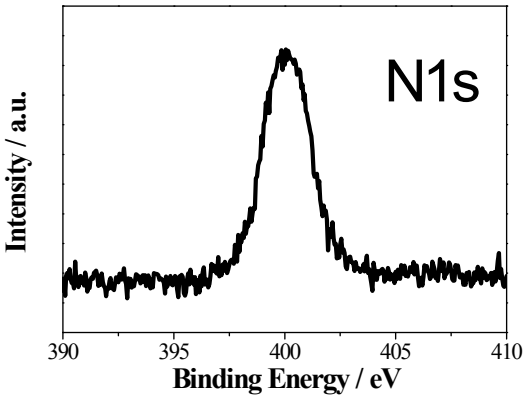


Fig. S5 N1s XPS spectrum of the obtained Pt-600 nanoparticles in the absence of GO.

Preparation of the Pt-600 nanoparticles: 0.8 mL of 0.05 M K_2PtCl_4 and 0.8 mL of 0.5 M PEI (Mw 600) solutions were added into 5 mL water with stirring for 30 min. Subsequently, 10 mL of 0.125 M $NaBH_4$ solution was slowly added into the mixture with stirring for 2 h. Finally, the Pt-600 nanoparticles was collected by centrifugation at 1200 rpm for 15 min, washed eight times with water, and then dried at 40 °C for 24 h in a vacuum dryer.