Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information

Newly-designed sandwich-structured graphene-Pt-graphene catalyst with improved electrocatalytic performance for fuel cells

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Fig. S1 shows XPS spectra of GO, Pt/graphene and G-P-G catalyst. The examination of the spectra of GO shows the presence of two peaks corresponding to C1s and O1s only. However, in the case of Pt/graphene and G-P-G catalyst, Pt 4f peak can be observed. In addition, the amount of oxygen-containing groups in G-P-G is relatively more than those in Pt/graphene, which is beneficial for methanol electrooxidation[1].

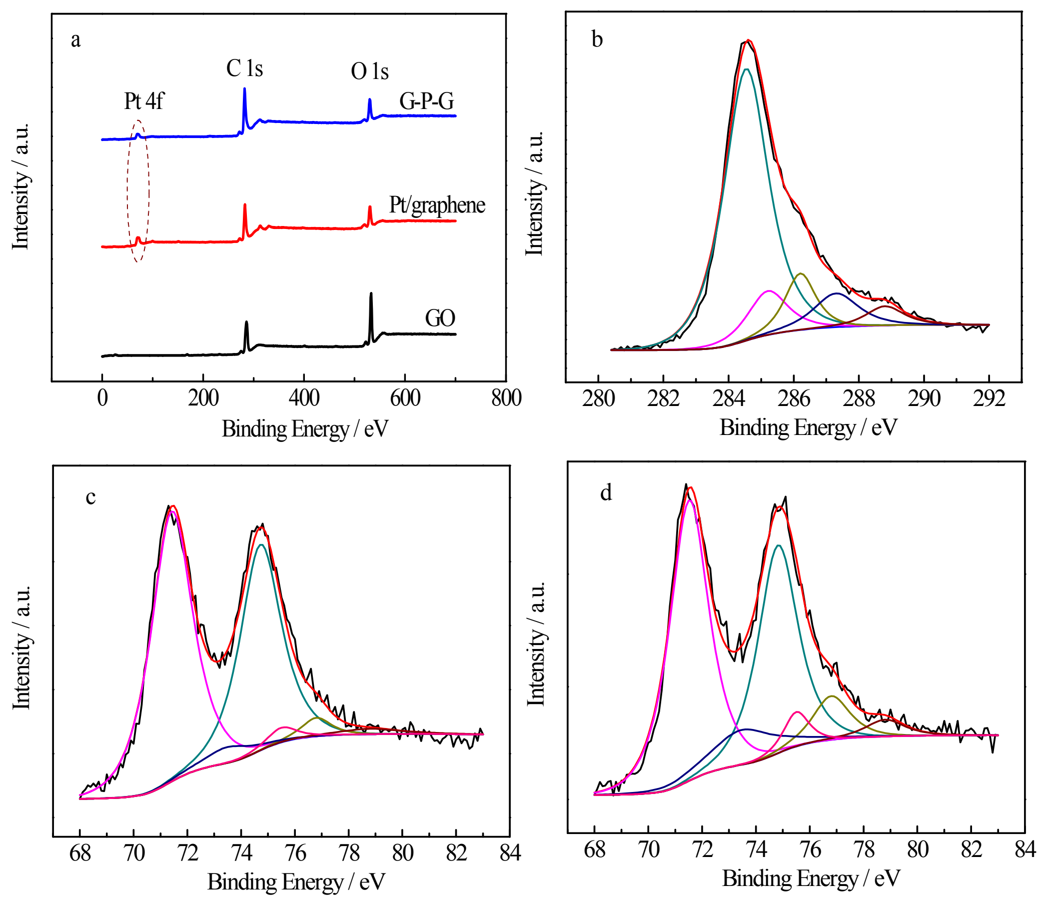

Fig. S1 XPS spectra of GO, Pt/graphene and G-P-G catalyst (a). XPS spectra of the C1s in Pt/graphene (b). XPS spectra of the Pt 4f in Pt/graphene (c) and G-P-G catalyst (d).

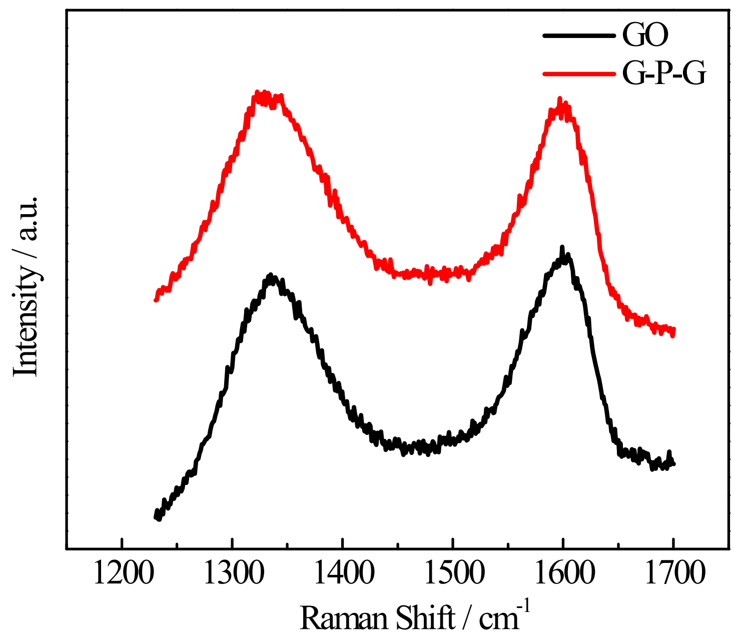

Fig. S2 Raman spectra of GO and G-P-G catalyst

Fig. S3 shows SEM (a,b) and TEM images (c,d) of G-P-G hybrid catalyst. Graphene and Pt NPs stack together orderly forming the unique layered stacking sandwich-structured G-P-G hybrid catalysts (a,b). G-P-G hybrid catalysts contain three layers of graphene. Distribution of Pt NPs is fairly uniform and the mean sizes of Pt NPs of the catalysts are estimated to be ~2 nm (c,d).

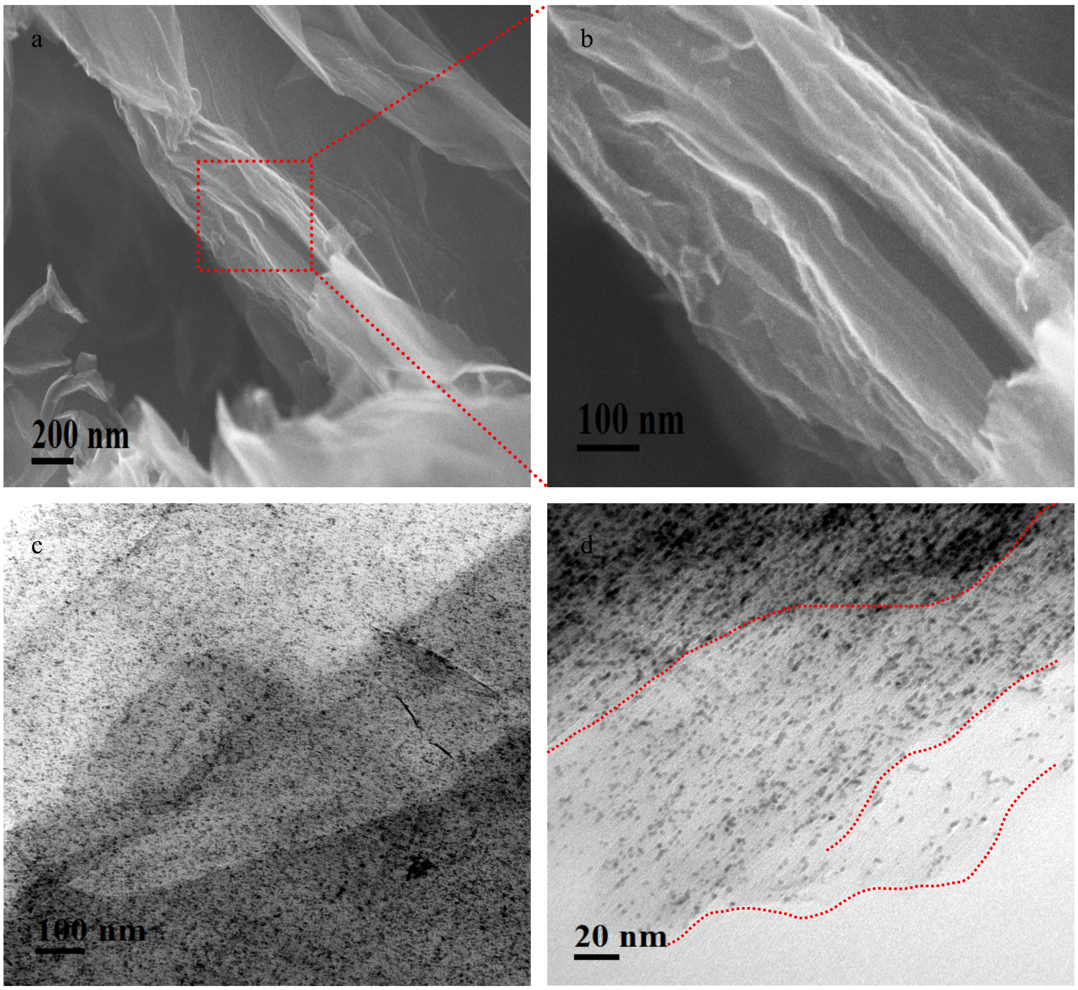

Fig. S3 SEM images (a,b) and TEM images (c,d) of G-P-G hybrid catalyst

Fig. S4 shows TEM images of Pt/graphene. It can been seen clearly that Pt NPs deposit on the almost transparent carbon sheets with a typically crumpled surface, and the distribution of Pt NPs is quite uniform. HRTEM (d) further confirm that lattice spacing of 0.227 nm corresponds to the (111) planes of face centered cubic (fcc) Pt. TEM results show morphology of Pt/graphene is entirely different from that of G-P-G catalyst.

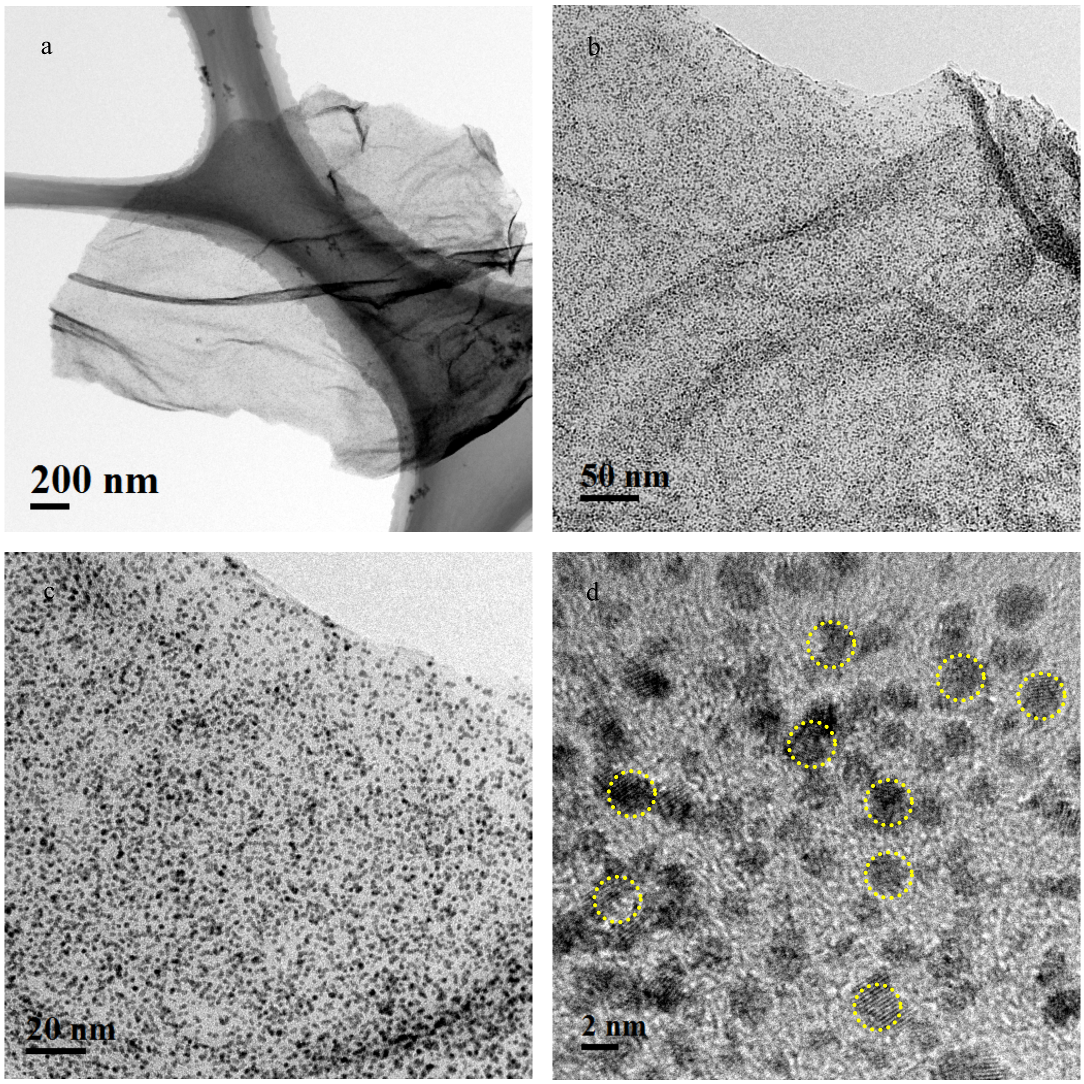

Fig. S4 TEM images of Pt/graphene catalyst

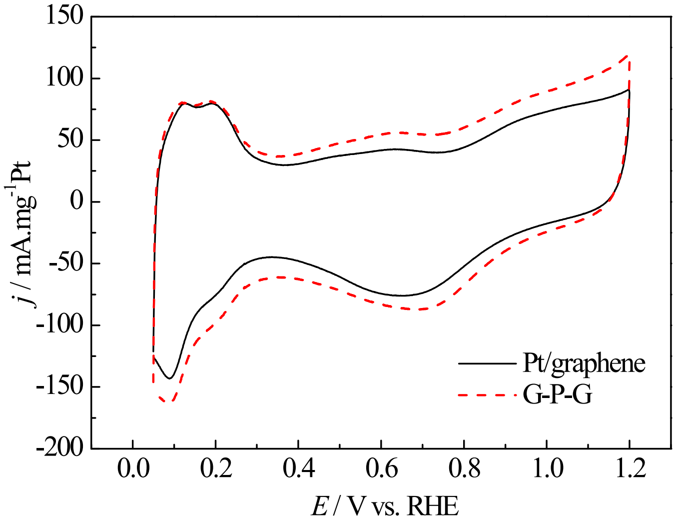

Fig. S5 CV of Pt/graphene and G-P-G catalysts in 0.5 mol L^{-1} H_2SO_4. Scanning rate: 50 mV s^{-1}; test temperature: 25 ^oC.

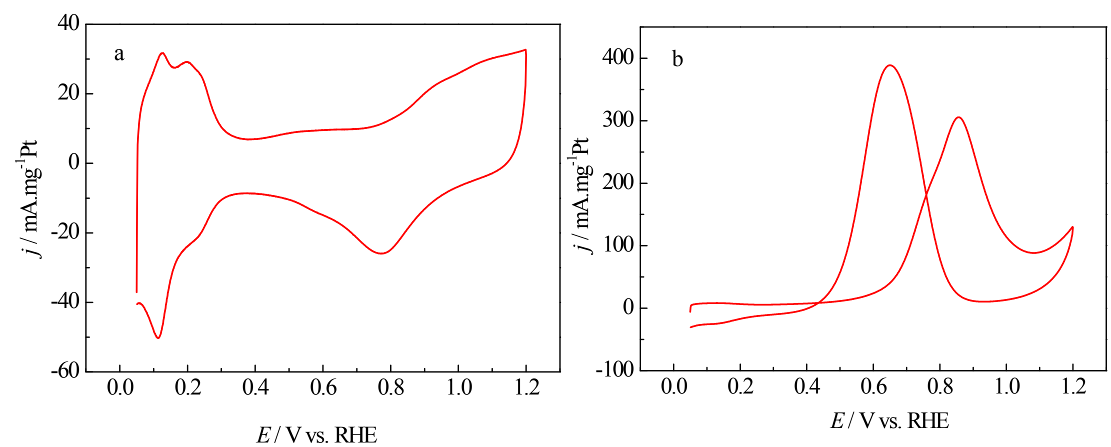

Fig. S6 CV of commercial Pt/C in a solution of 0.5 mol L^{-1} H_2SO_4 (a) and 0.5 mol L^{-1} H_2SO_4 containing 0.5 mol L^{-1} CH_3OH (b). Scanning rate: 50 mV s^{-1}; test temperature: 25 ^oC.

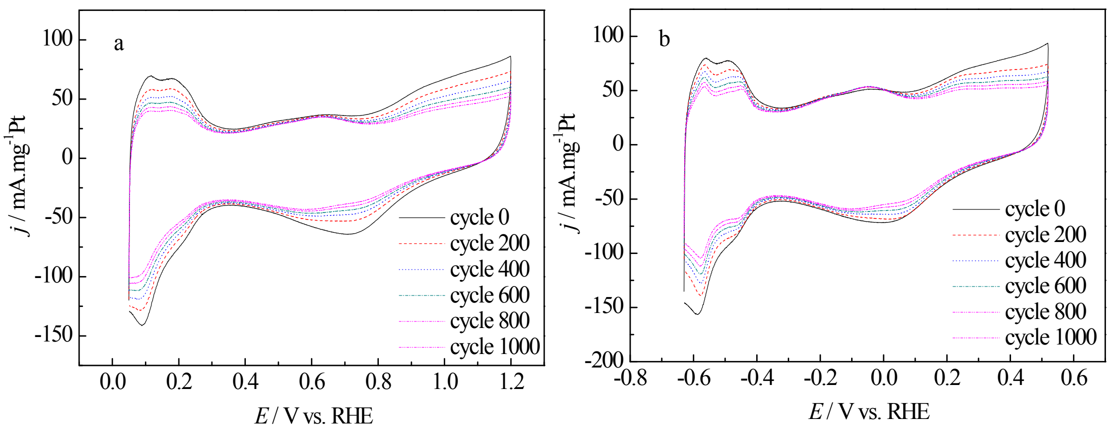

Fig. S7 CV in 0.5 mol L^{-1} H_2SO_4 for Pt/graphene-TiO_2 (a) and G-Pt/TiO_2-G catalysts (b) during the APCT. Scanning rate: 50 mV s^{-1}; test temperature: 25 ^{o}C.

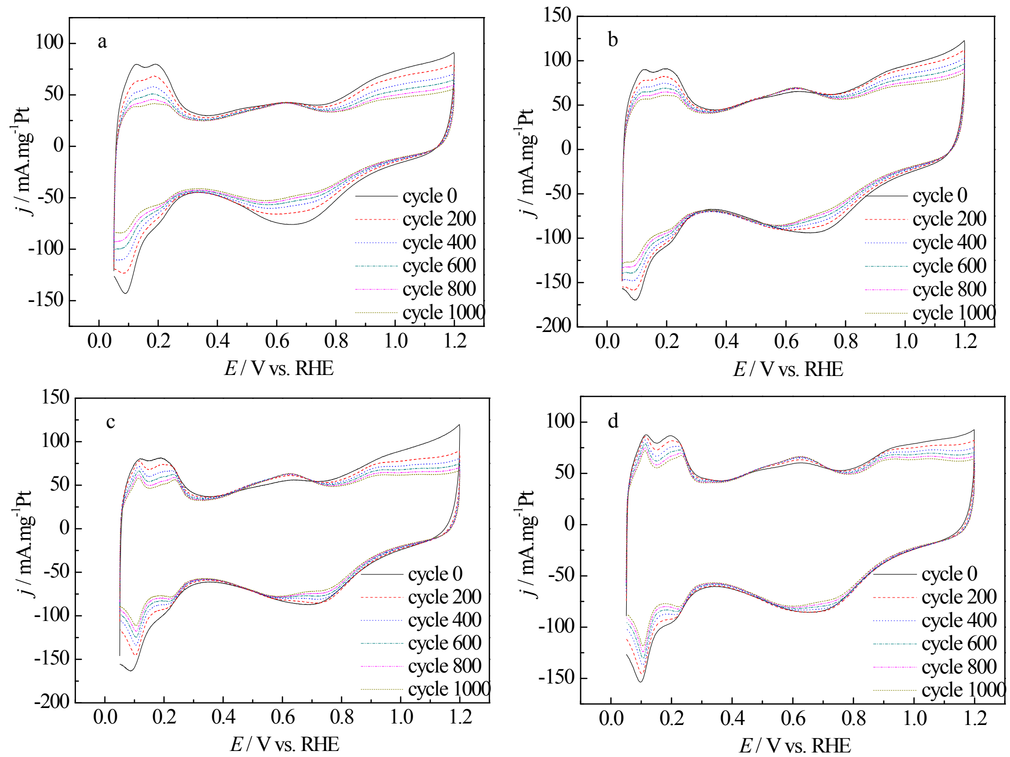

Fig. S8 CV in 0.5 mol L^{-1} H_2SO_4 for Pt/graphene (a), G-P-G_{30} (b), G-P-G_{50} (c) and G-P-G_{80} (d) catalysts during the APCT. Scanning rate: 50 mV s^{-1}; test temperature: 25 ^{o}C.

References

1. Y. Hu, P. Wu, Y. Yin, H. Zhang and C. Cai, Appl. Catal. B: environ., 2012, 111–112, 208-217.