# Supporting materials for

# Design and synthesis of Pd/$MnO_2$ nanolamella/graphene composite as a high-performance multifunctional electrocatalyst towards formic acid and methanol oxidation

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**Supplementary Results**

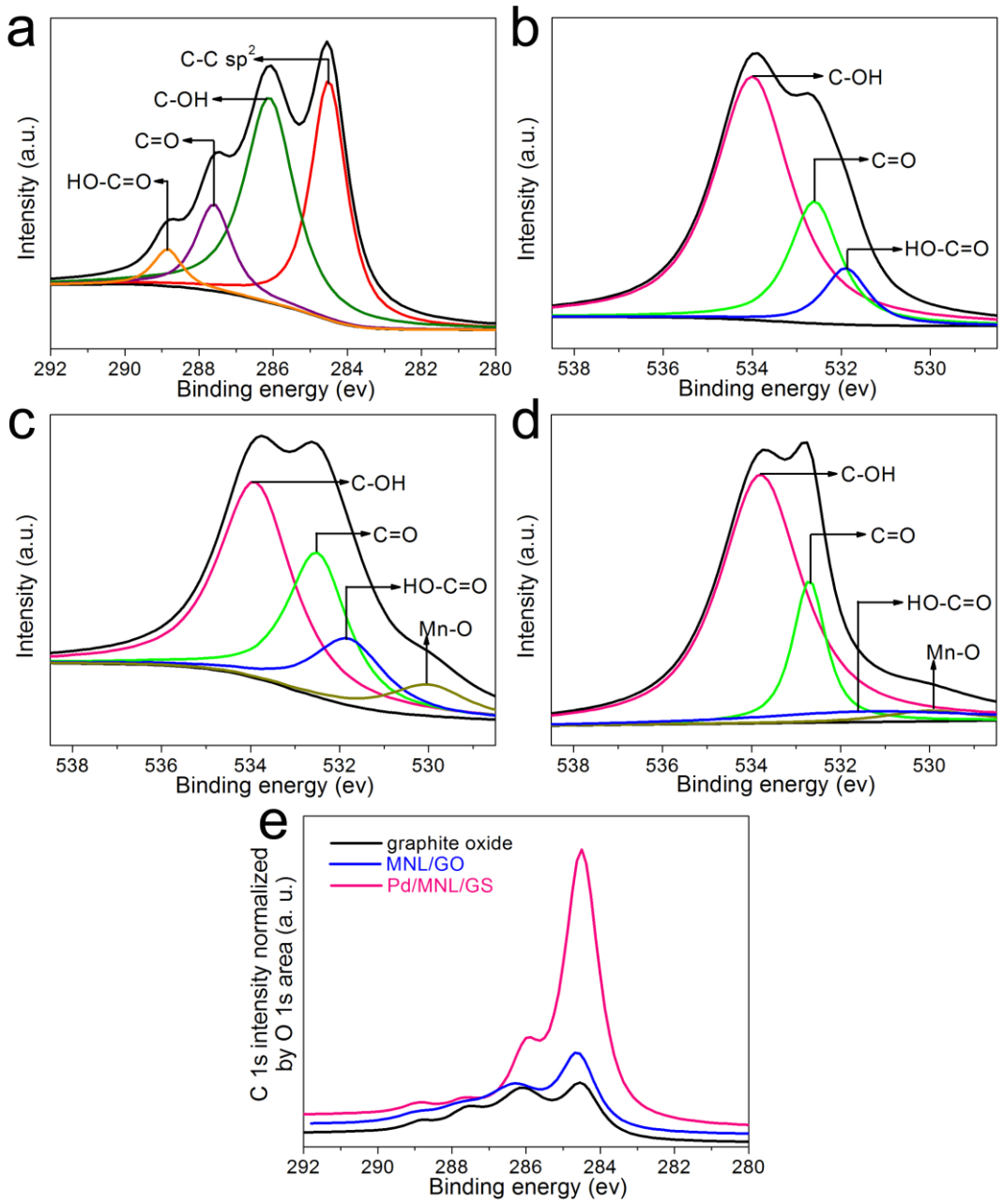


**Fig. S1** (a) C 1s core-level XPS spectrum of graphite oxide; O 1s core-level XPS spectra of (b) graphite oxide, (c) MNL/GO and (d) Pd/MNL/GS; (e) Normalized C 1s XPS spectra of graphite oxide, MNL/GO and Pd/MNL/GS.

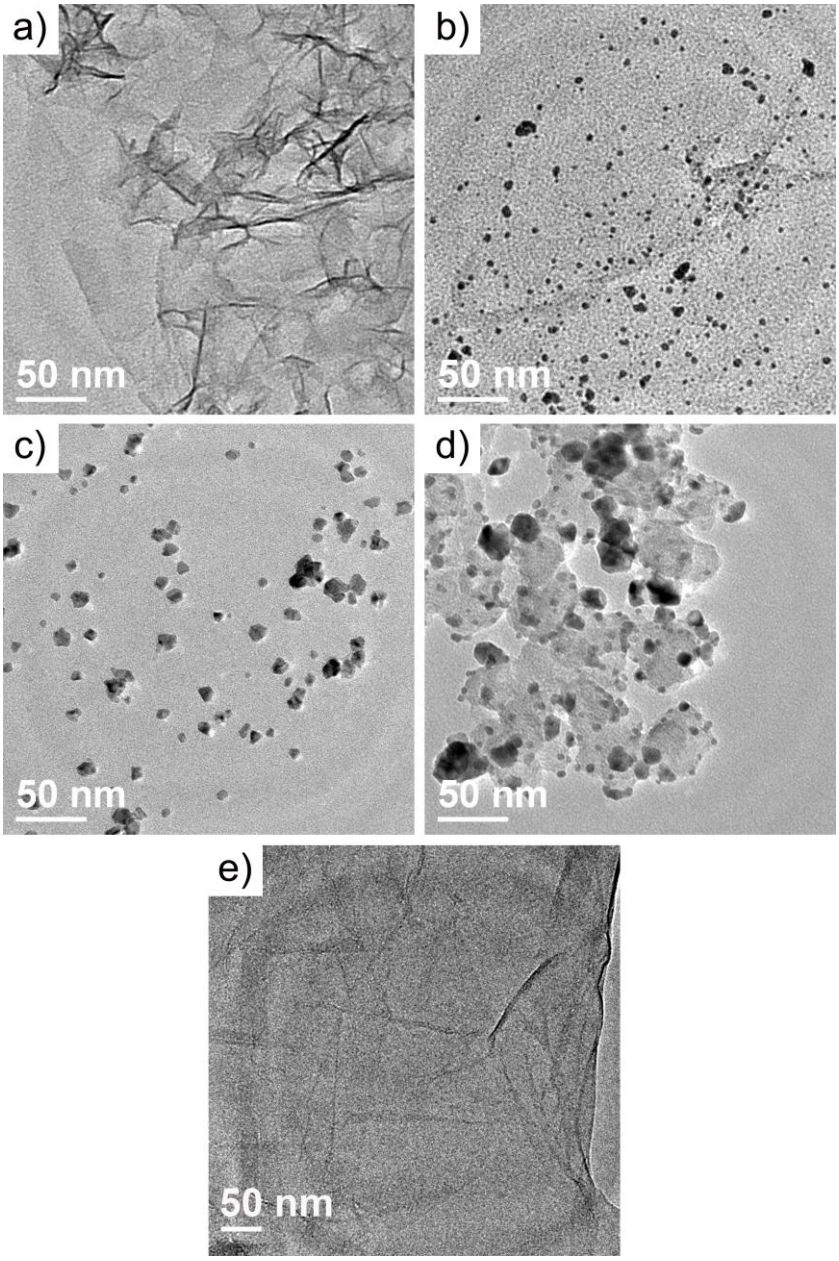


**Fig. S2** High magnification TEM images of (a) MNL/GO, (b) Pd/MNL/GS, (c) Pd/GS, (d) Pd/XC-72 and (e) GO.

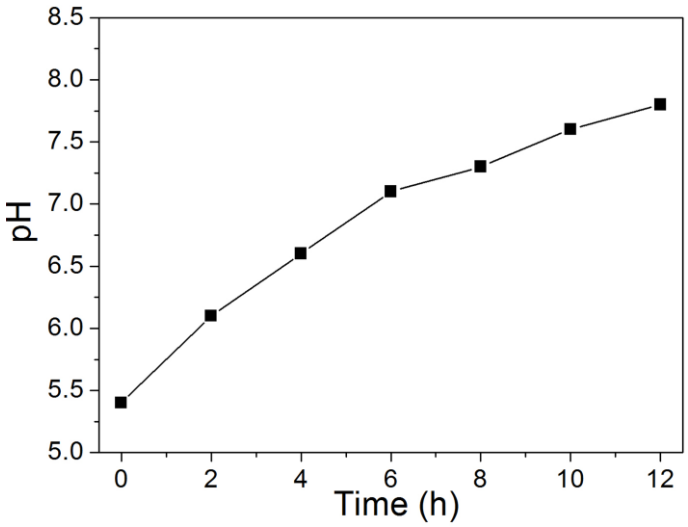


**Fig. S3** Dependence of the solution pH value on the reaction time.

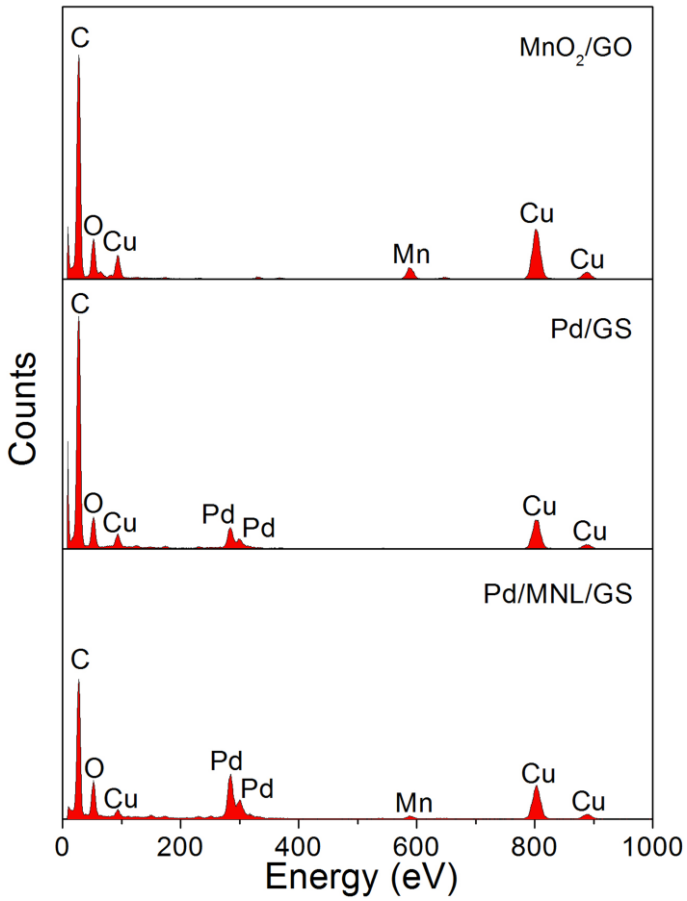


**Fig. S4** EDX spectra of (a) MNL/GO, (b) Pd/GS and (c) Pd/MNL/GS.

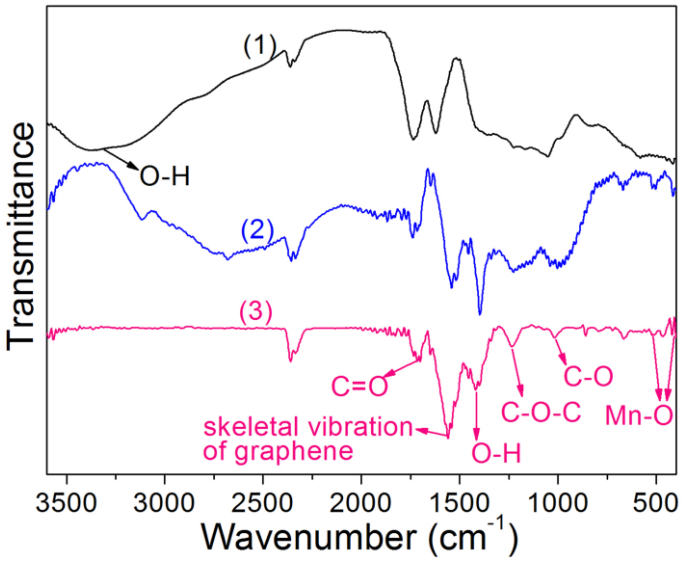


**Fig. S5** FT-IR spectra of (1) graphite oxide, (2) MNL/GO and (3) Pd/MNL/GS.

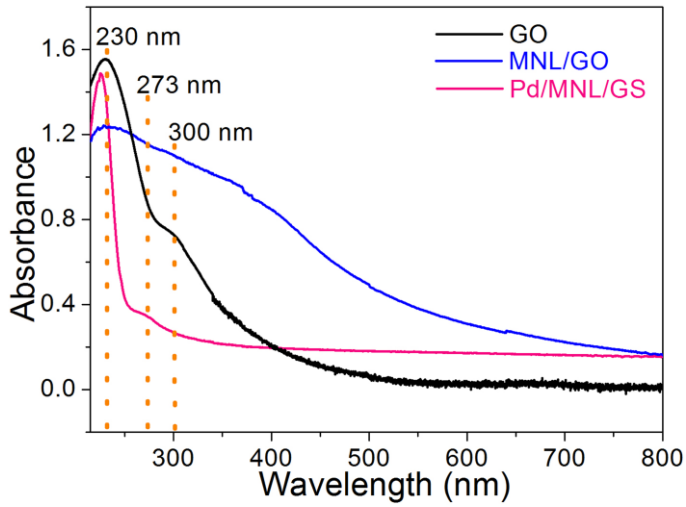


**Fig. S6** UV-vis absorption spectra of GO, MNL/GO and Pd/MNL/GS.

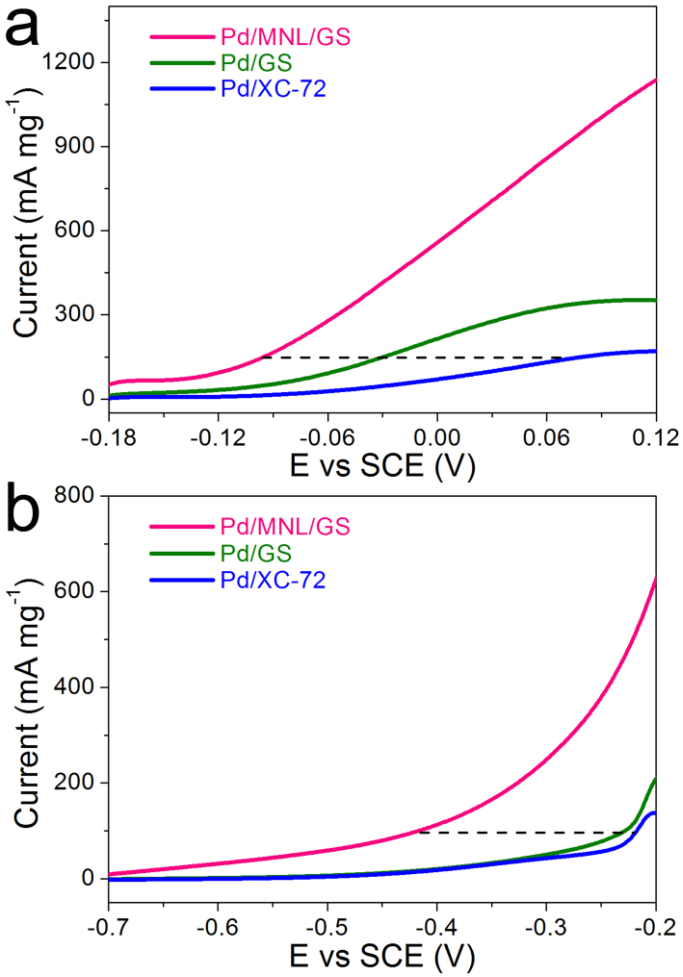


**Fig. S7** Linear sweep voltammetrys of Pd/MNL/GS, Pd/GS and Pd/XC-72 in (a) 0.5 M $H_2SO_4$ solution with 0.5 M HCOOH and (b) 0.5 M NaOH solution with 1 M methanol at 50 mV $s^{-1}$.

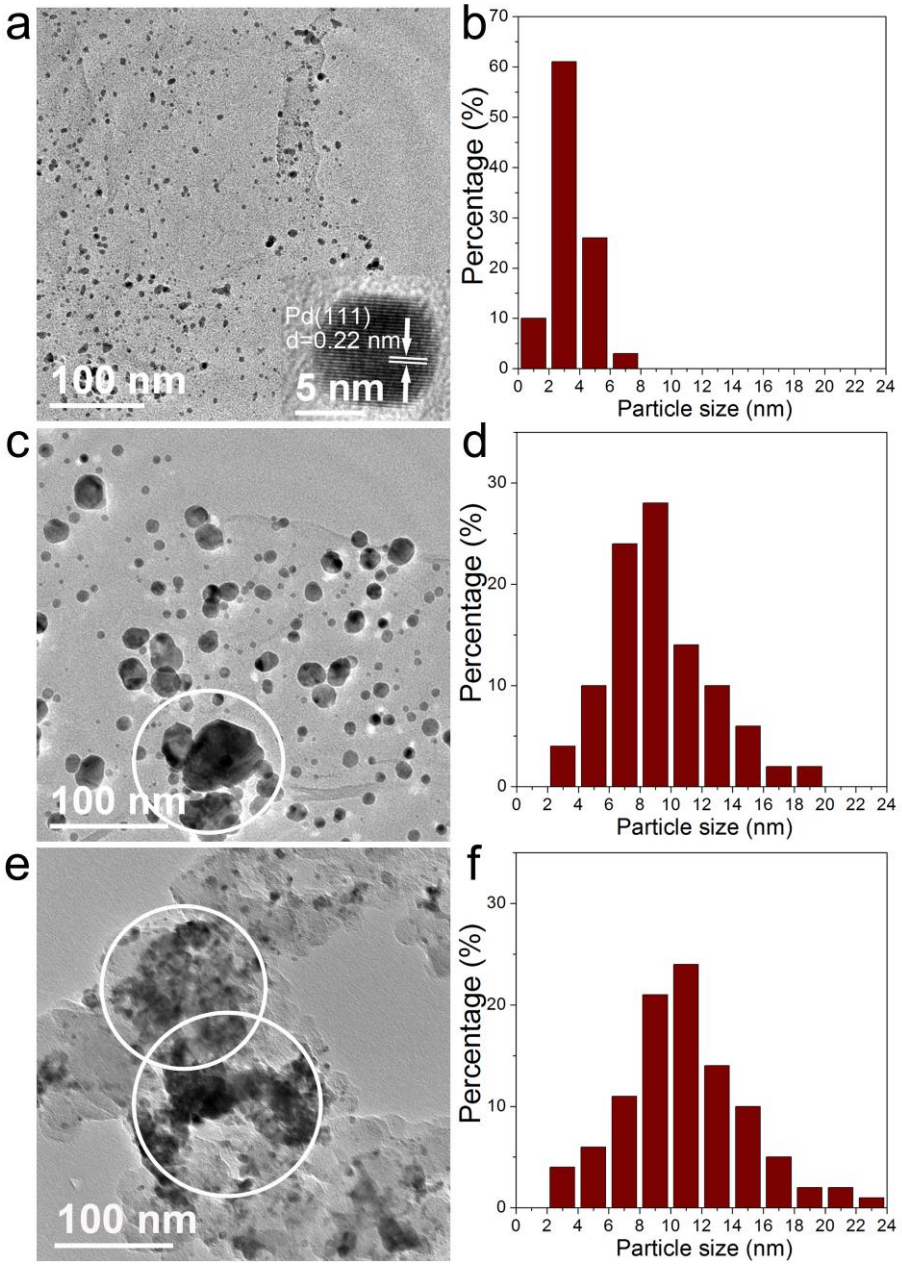


**Fig. S8** TEM images and histograms of Pd particle size distributions of the (a-b) Pd/MNL/GS, (c-d) Pd/GS and (e-f) Pd/XC-72 catalysts subjected to a durability test process. The inset of (a) is an HRTEM image of Pd/MNL/GS.

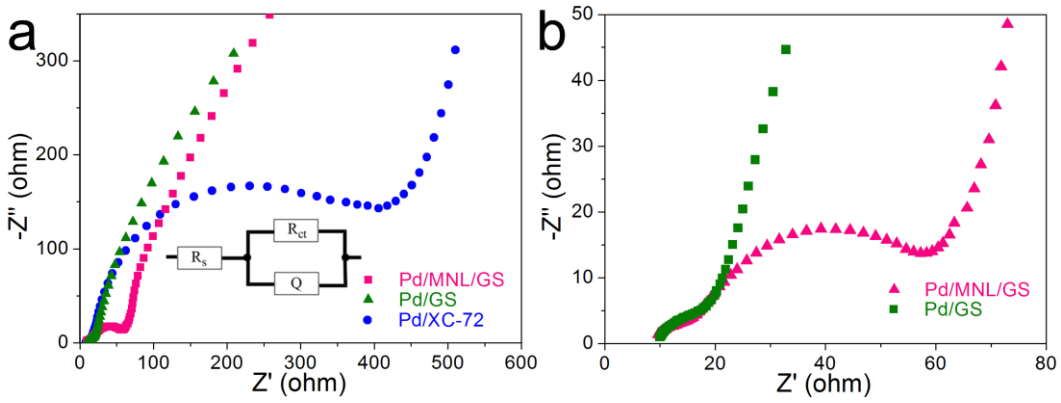


**Fig. S9** (a) Nyquist plots of EIS for Pd/MNL/GS, Pd/GS and Pd/XC-72 in 0.5 M $H_2SO_4$ solution with 0.5 M HCOOH. The inset is the equivalent circuit used to fit the impedance spectra. (b) Local enlargement of the Nyquist plots for Pd/MNL/GS and Pd/GS.

**Table S1** Impedance components for Pd/MNL/GS, Pd/GS and Pd/XC-72 electrodes by fitting the experimental data using ZsimpWin software based on the equivalent circuit presented in the inset of Fig. S9a.

| Electrode | $R_{ct}$ | |
|---|---|---|
| | value (ohm) | error (%) |
| Pd/MNL/GS | 57.4 | 5.9 |
| Pd/GS | 25.2 | 8.8 |
| Pd/XC-72 | 563.3 | 5.9 |