## Supporting Information

# Pt nanocrystals on nitrogen-doped graphene for hydrogen evolution reaction using Si nanowires as a sacrifice template

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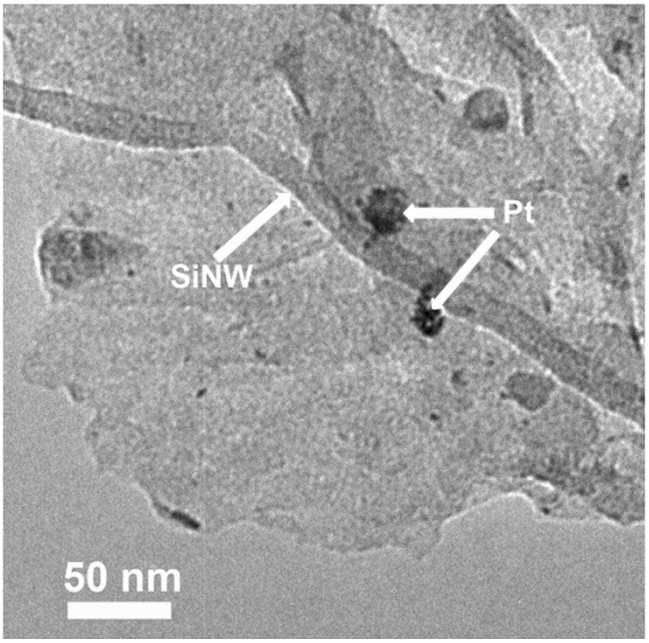


**Figure S1**. TEM image showing Pt was grown between a SiNW and N-graphene.

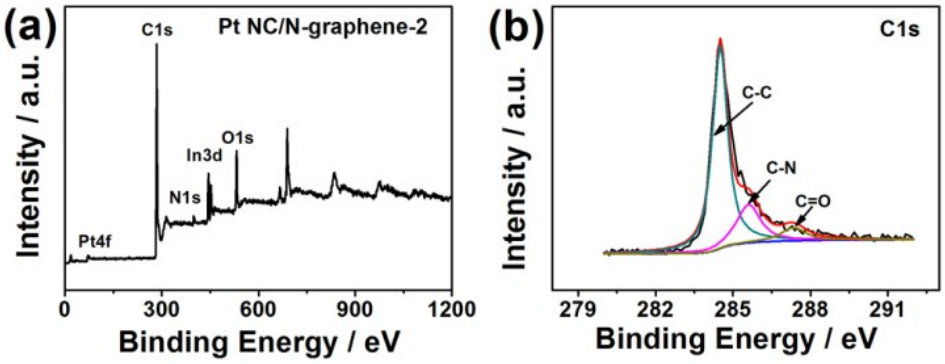


**Figure S2.** The full (a) and high-resolution C1s (b) XPS spectra of Pt NC/N-graphene-2.

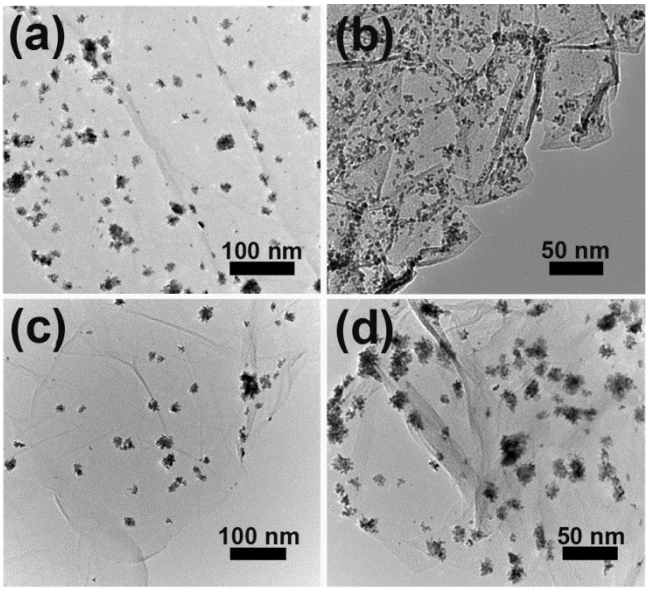


**Figure S3.** TEM images of (a) Pt NC/rGO, (b) Pt NP/N-graphene, (c) Pt NC/N-graphene-1 and (d) Pt NC/N-graphene-3.

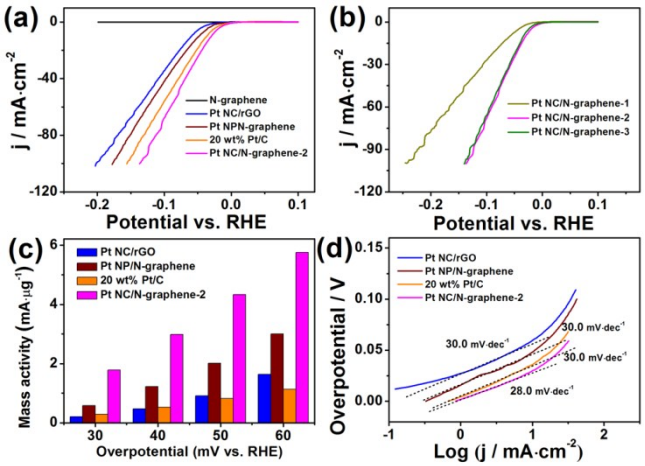


**Figure S4.** (a) LSV curves of N-graphene, Pt NC/rGO, Pt NP/N-graphene, 20 wt% Pt/C and Pt NC/N-graphene-2 catalysts without the iR-compensation; (b) LSV curves of different Pt NC/N-graphene catalysts without the iR-compensation; (c) the mass activity of all catalysts at the different overpotentials; and (d) the corresponding Tafel plots derived from (a).

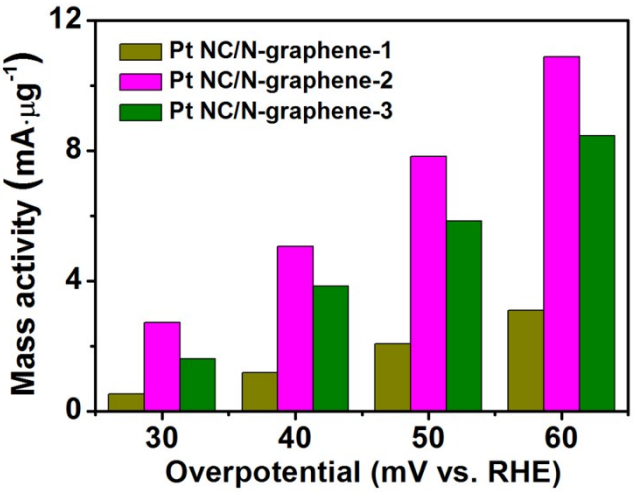


**Figure S5.** The mass acitivities of Pt NC/N-graphene-1, Pt NC/N-graphene-2 and Pt NC/N-graphene-3 with the iR-compensation.

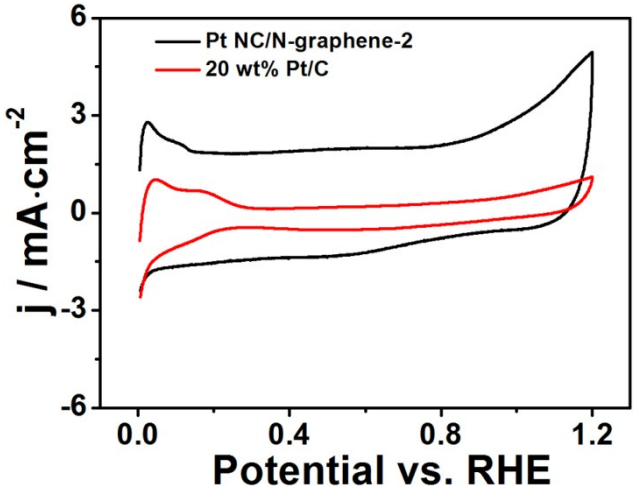


**Figure S6.** CVs of Pt NC/N-graphene-2 and 20 wt% Pt/C in $N_2$-saturated 0.5 M $H_2SO_4$ solution, indicating the electrochemical active surface areas of 91 and 59 $m^2g^{-1}$ for Pt NP/N-graphene-2 and 20 wt% Pt/C catalysts, respectively.

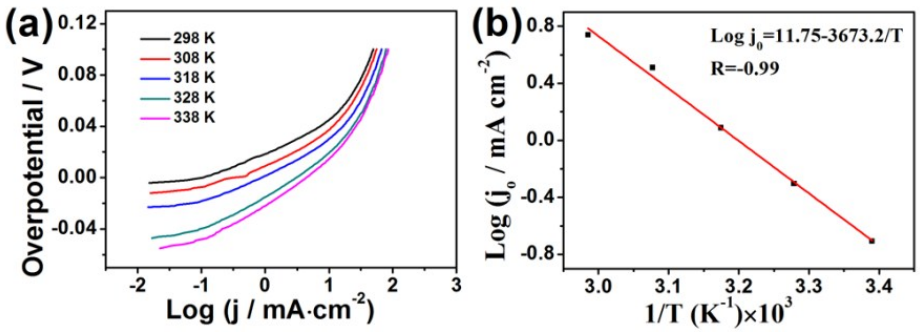


**Figure S7.** (a) Tafel curves of Pt NC/N-graphene-2 at different temperatures without the iR-compensation; and (b) the corresponding Arrhenius plot.

The electrochemical active energy of the Pt NC/N-graphene-2 catalyst was carried out by LSV in $N_2$ saturated 0.5 M $H_2SO_4$ solution at different temperatures ranging from 298 to 338 K. The Tafel curves presented similar Tafel slopes at different temperatures (Figure S7(a)). The exchange current density $j_0$ was derived from the Tafel curves and the Arrhenius plot is displayed in Figure S7 (b). The linear function of Log$j_0$ against $T^{-1}$ was plotted and electrochemical activation energy $\Delta G_0$ was 70.3

kJ·moL$^{-1}$ according to the following equation.[S1]

$$\text{Log}j_0 = \text{Log}(FK_C) - \Delta G_0/2.303RT,$$

where $\Delta G_0$ is the apparent activation energy.

## Reference

S1 L. L. Zhu, Q. Cai, F. Liao, M. Q. Sheng, B. Wu and M. W. Shao, *Electrochem. Commun.*, 2015, **52**, 29–33.