Supporting Information

Boosting oxygen reduction activity of nano-graphene catalyst by charge redistribution at graphene-metal interface

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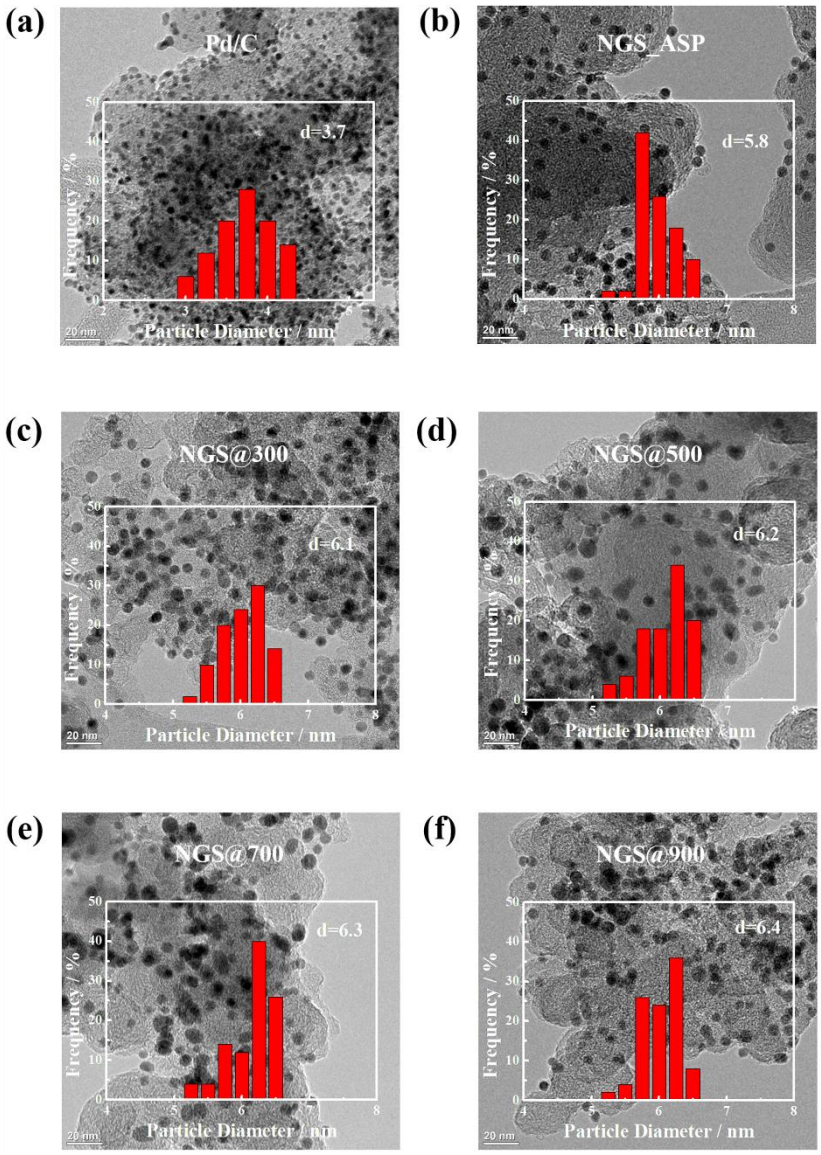

Fig. S1. TEM images and particle size distribution of (a) commercial Pd/C, (b) NGS_ASP, (c) NGS@300, (d) NGS@500, (e) NGS@700, and (f) NGS@900.

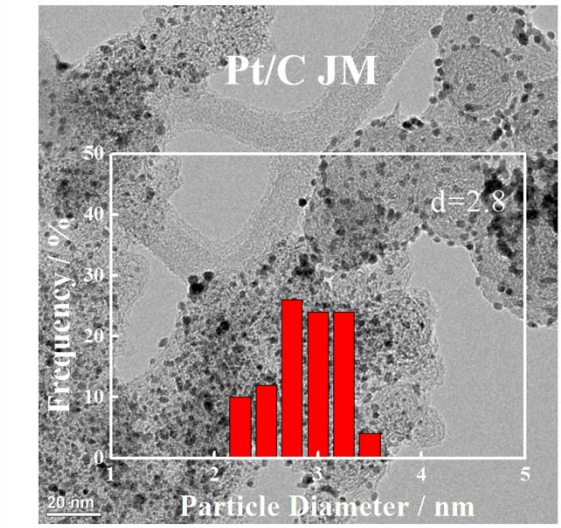

Fig. S2. TEM image and particle size distribution of commercial Pt/C catalyst.

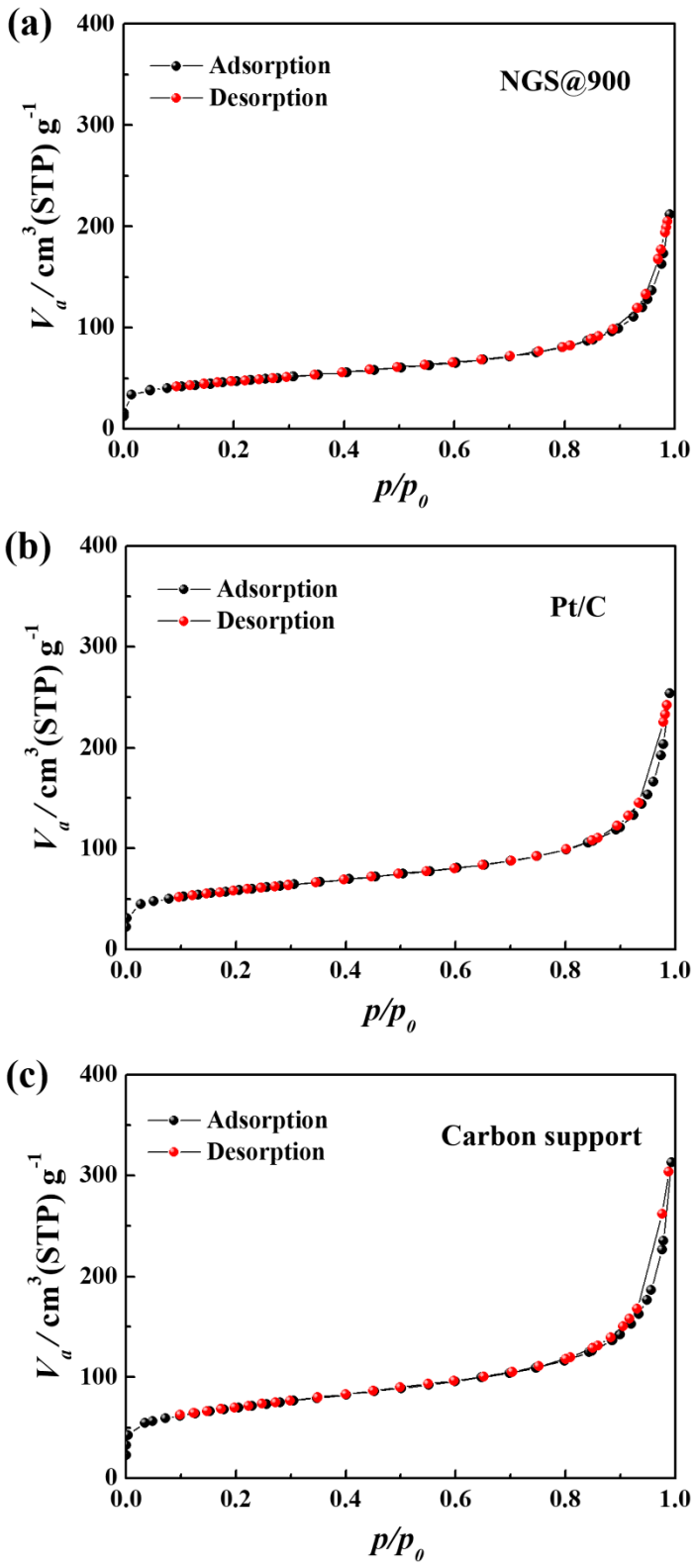

Fig. S3. Nitrogen adsorption-desorption isotherms of (a) NGS@900, (b) Pt/C, and (c) carbon support.

Table S1. Specific surface areas and total pore volumes of NGS@900, Pt/C, and carbon support (Vulcan carbon) obtained by Brunauer-Emmett-Teller (BET) analysis.

Sample	**NGS@900**	**Pt/C**	**Carbon support**
Specific surface area (m^2/g)	163	204	244
Total pore volume (cm^3/g)	0.32	0.39	0.46

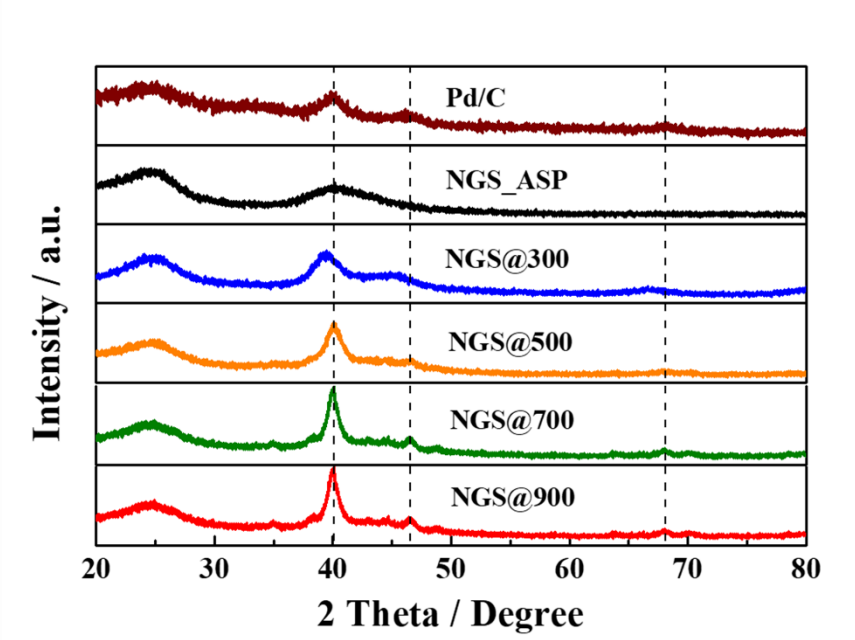

Fig. S4. XRD patterns of commercial Pd/C and NGS catalysts.

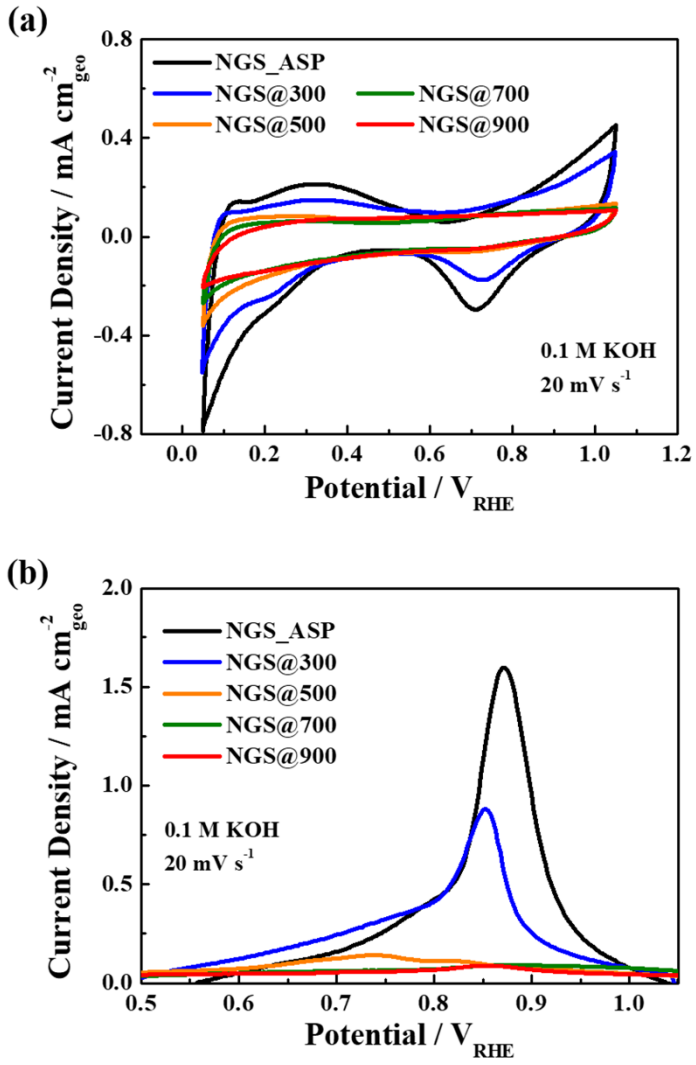

Fig. S5. (a) CVs and (b) CO stripping curves of NGS catalysts.

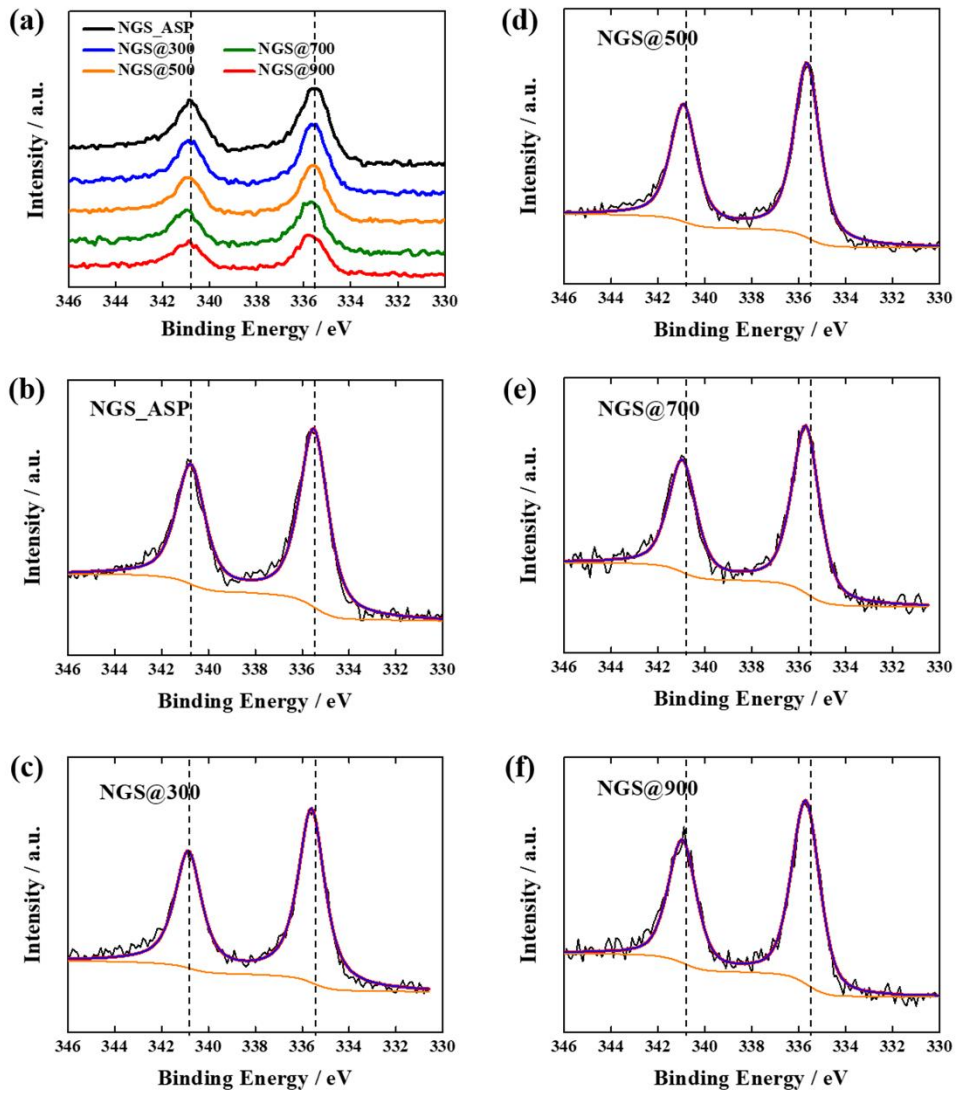

Fig. S6. Pd 3*d* core-level XPS spectra of NGS catalysts.

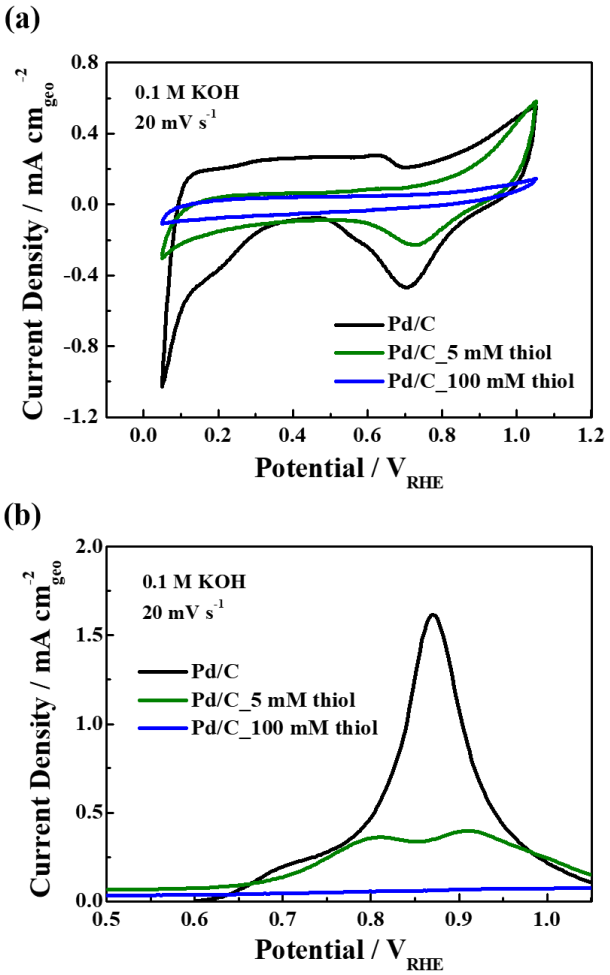

Fig. S7. (a) CVs and (b) CO stripping curves of commercial Pd/C and allyl mercaptan-modified Pd/C catalysts.

Koutecky-Levich plots:

The number of electrons transferred for ORR on NGS@900 and Pt/C catalysts was calculated according to the Koutecky-Levich equation:

$$1/J = 1/J_D + 1/J_K = 1/(B\omega^{1/2}) + 1/J_K$$

$$B = 0.62nFC_oD_o^{2/3}\nu^{-1/6}$$

where J_D is the diffusion-limiting current, J_K is the kinetic current, F is the Faraday constant (96485 C mol^{-1}), D_o is the diffusion coefficient of oxygen in 0.1 M KOH (1.9×10^{-5} cm^2 s^{-1}), ν is the kinematic viscosity of electrolyte (1.09×10^{-2} cm^2 s^{-1}), C_o is the bulk concentration of oxygen in 0.1 M KOH (1.2×10^{-6} mol cm^{-3}), ω is the angular velocity (rad s^{-1}), and n is the electron transfer number for the ORR.

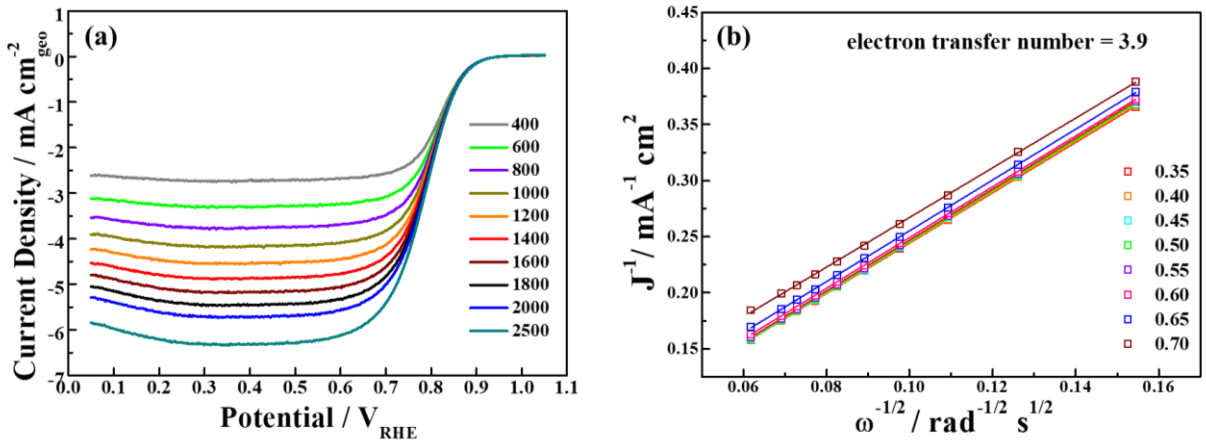

Fig. S8. (a) LSV curves of NGS@900 at different rotation speed (400 to 2500 rpm) in O_2-saturated 0.1 M KOH at a scan rate of 5 mV s^{-1}. (b) Koutecky-Levich plots for NGS@900 catalyst at different potentials.

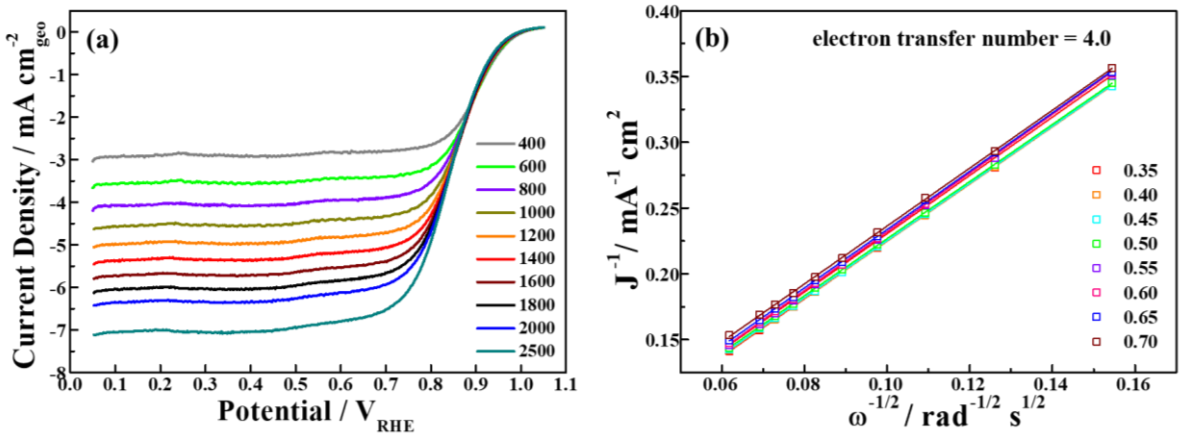

Fig. S9. (a) LSV curves of Pt/C at different rotation speed (400 to 2500 rpm) in O_2-saturated 0.1 M KOH at a scan rate of 5 mV s^{-1}. (b) Koutecky-Levich plots for Pt/C catalyst at different potentials.

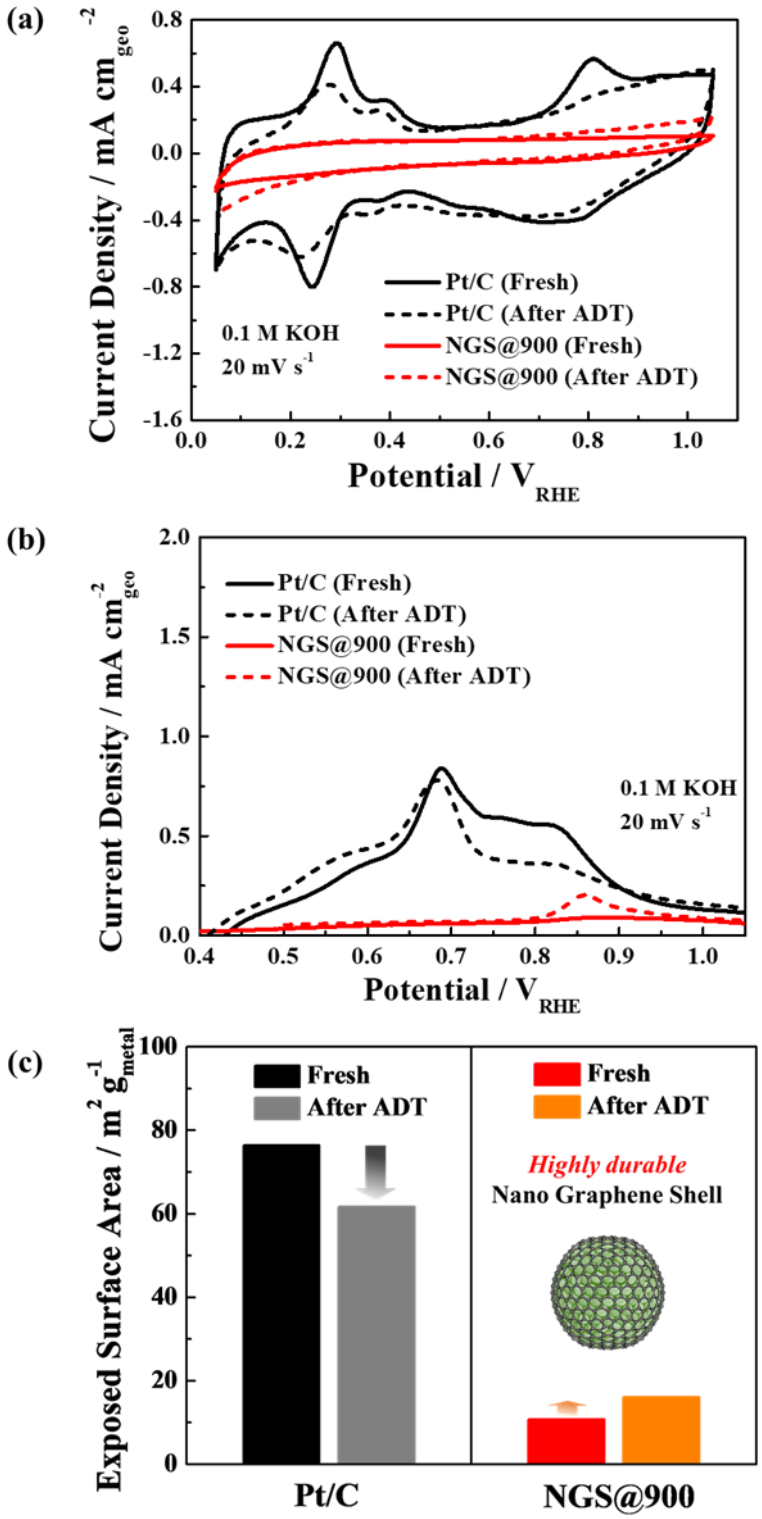

Fig. S10. (a) CVs and (b) CO stripping curves and (c) change in the metal surface areas of commercial Pt/C and NSG@900 before and after ADTs.

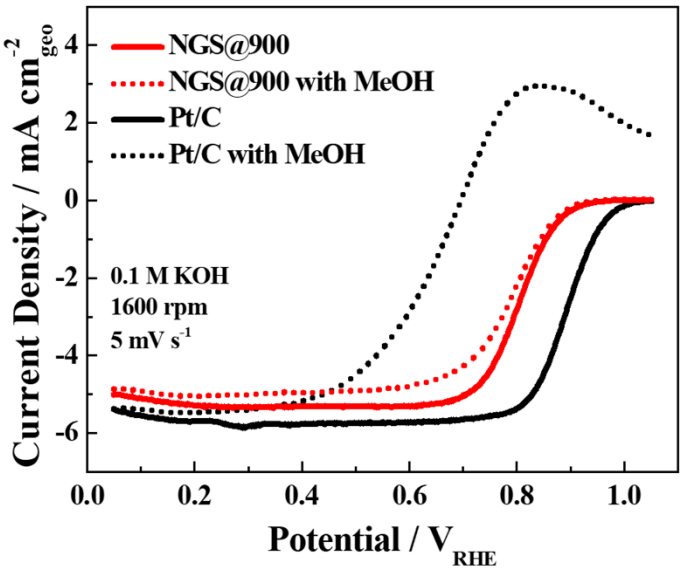

Fig. S11 ORR polarization curves of NGS@900 and Pt/C in 0.1 M KOH without (solid line) and with (dotted line) 0.5 M MeOH.