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

Electronic Supplementary Information

Decoupled Hydrogen Evolution from Water/Seawater Splitting by Integrating Ethylene Glycol Oxidation on $PtRh_{0.02}$@Rh Nanowires with Rh Atoms Modifying

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Figure

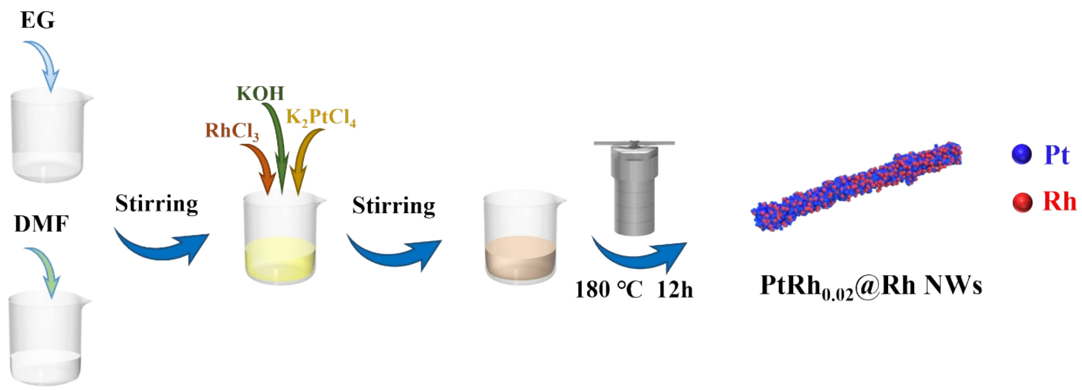

Fig. S1. The synthesis process of $PtRh_{0.02}$@Rh NWs.

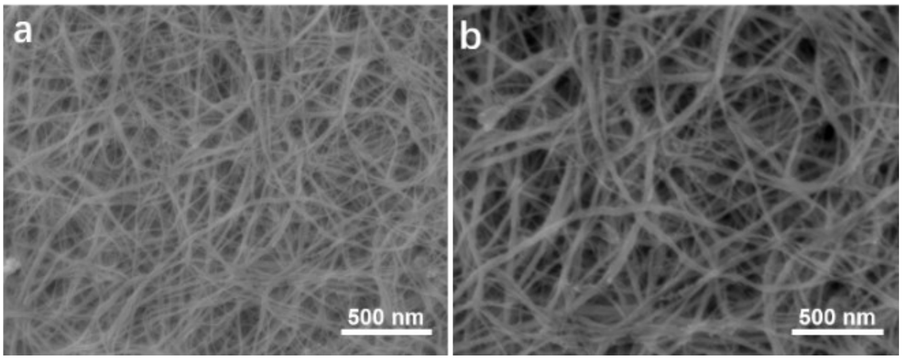

Fig. S2. The SEM images of (a) $PtRh_{0.1}$@Rh NWs, (b) $PtRh_{0.34}$@Rh NWs.

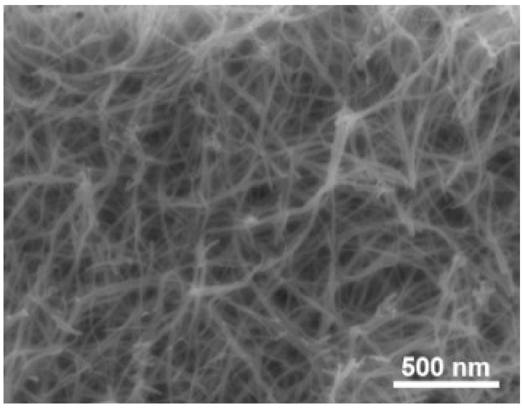

Fig. S3. The SEM image of Pt NWs.

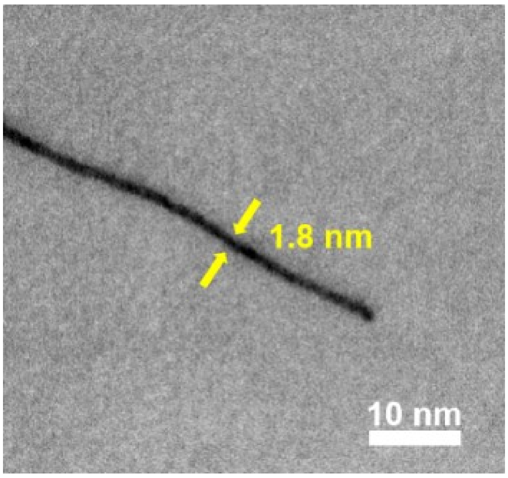

Fig. S4. The TEM image of single ultrafine $PtRh_{0.02}$@Rh NWs.

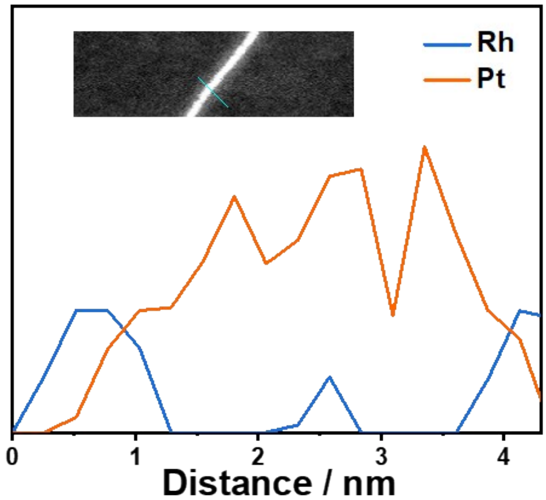

Fig. S5. The line scan of single $PtRh_{0.02}$@Rh NWs.

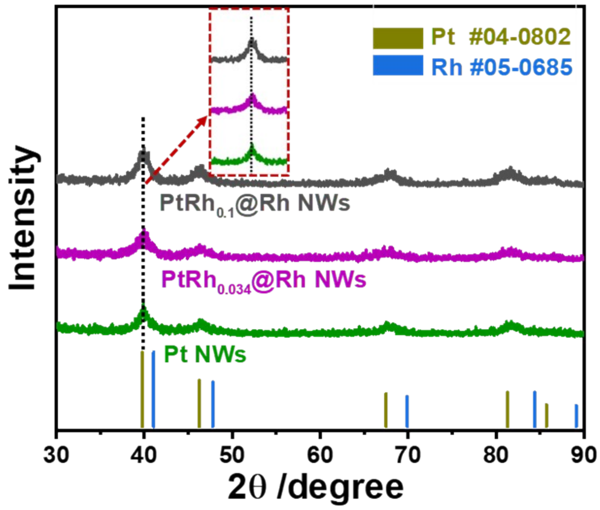

Fig. S6. The PXRD pattern of $PtRh_{0.1}$@Rh NWs, $PtRh_{0.034}$@Rh NWs, and Pt NWs.

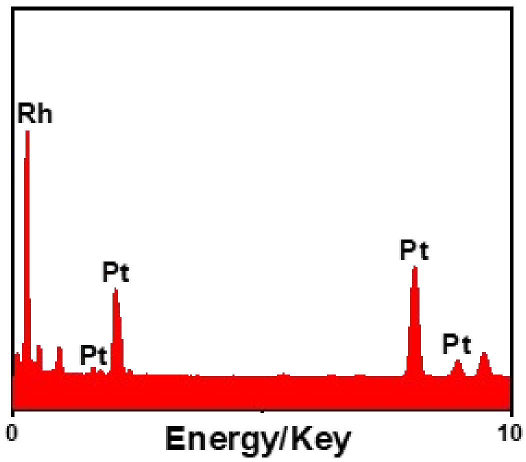

Fig. S7. The EDX result of $PtRh_{0.02}$@Rh NWs.

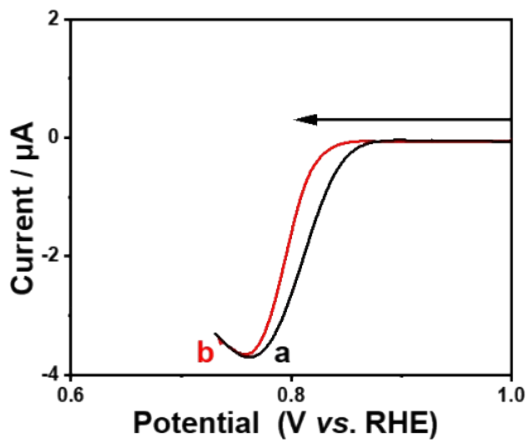

Fig. S8. The LSV curves of the reduction potential of (a) Pt^{II} precursor to Pt^0 and (b) Rh^{III} precursor to Rh^0.

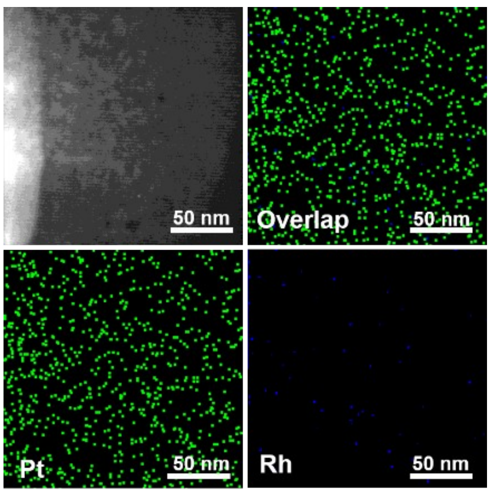

Fig. S9. The elemental mappings of Pt nanoparticles at the first formation stage of $PtRh_{0.02}$@Rh NWs.

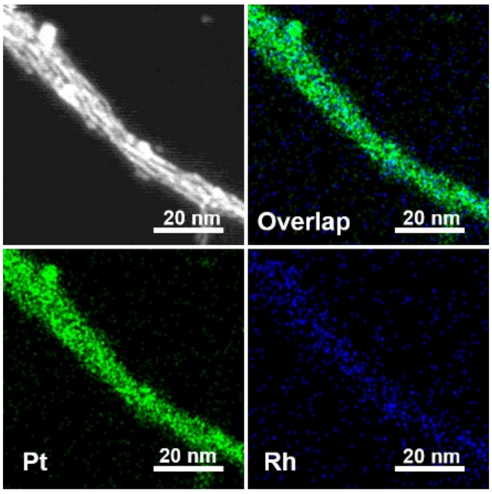

Fig. S10. The elemental mappings of PtRh NWs after maintaining 1 h at 180 °C.

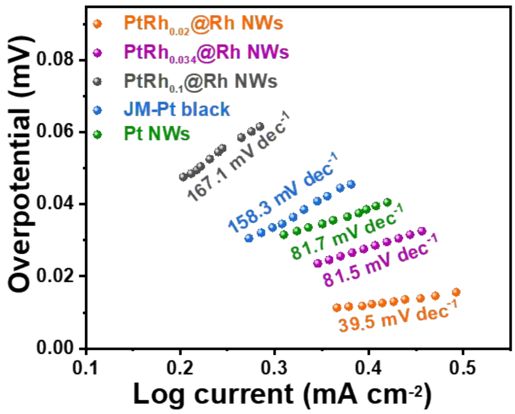

Fig. S11. The Tafel plots of $PtRh_{0.02}$@Rh NWs, $PtRh_{0.034}$@Rh NWs, $PtRh_{0.1}$@Rh NWs, Pt NWs, and JM-Pt black in alkaline seawater, respectively.

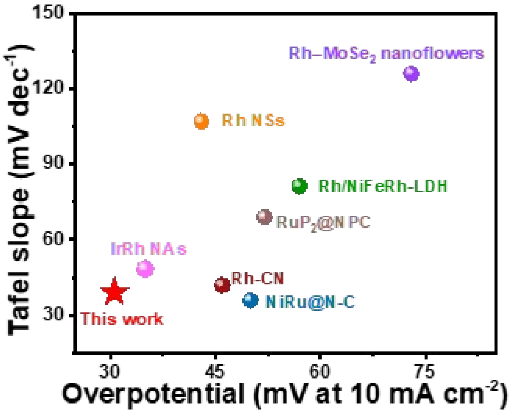

Fig. S12. Comparison of overpotential at the current densities of 10 mA cm^{-2} and Tafel slopes for the state-of-the-art HER catalysts in alkaline media.

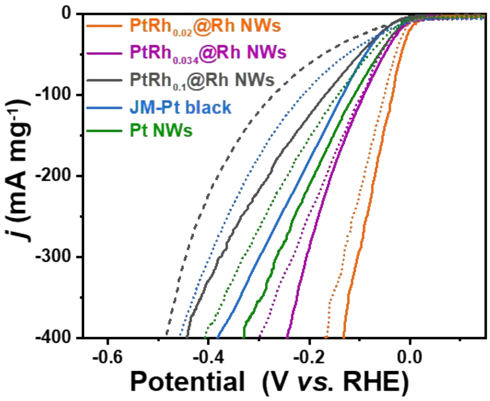

Fig. S13. Polarization curves of $PtRh_{0.02}$@Rh NWs, $PtRh_{0.034}$ @Rh NWs, $PtRh_{0.1}$ @Rh NWs, Pt NWs, and JM-Pt black in alkaline fresh water and alkaline seawater, respectively.

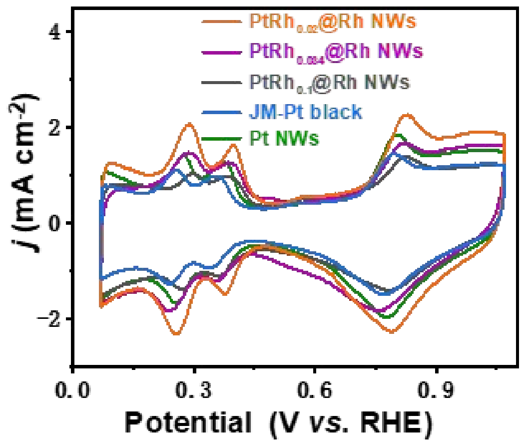

Fig. S14. The CV curves of Pt NWs, $PtRh_{0.02}$@Rh NWs, $PtRh_{0.034}$@Rh NWs, $PtRh_{0.1}$@Rh NWs, and JM-Pt black in N_2-saturated 0.1 M KOH solution.

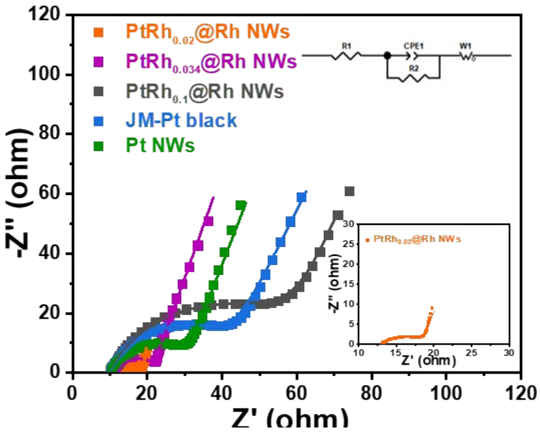

Fig. S15. The Nyquist plots of Pt NWs, $PtRh_{0.02}$@Rh NWs, $PtRh_{0.034}$@Rh NWs, $PtRh_{0.1}$@Rh NWs, and JM-Pt black at 50 mV vs. RHE.

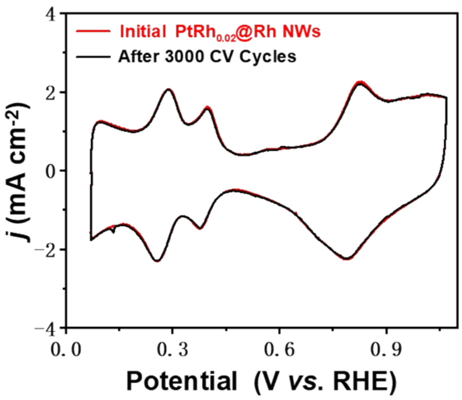

Fig. S16. The CV curves of $PtRh_{0.02}$@Rh NWs in N_2-saturated 0.1 M KOH solution with a scan rate of 50 mV·s^{-1}.

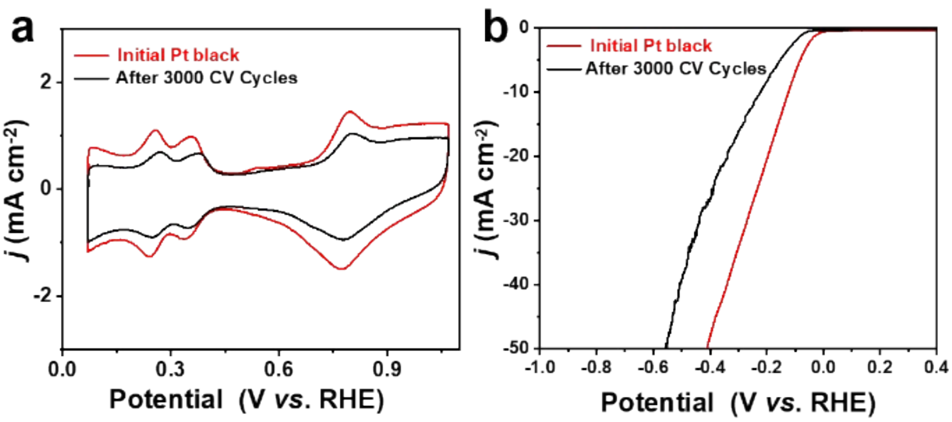

Fig. S17. (a) The CV curves of Pt black in N_2-saturated 0.1 M KOH solution with a scan rate of 50 mV·s^{-1}. (b) Polarization curves of Pt black before and after 3000 CV cycles.

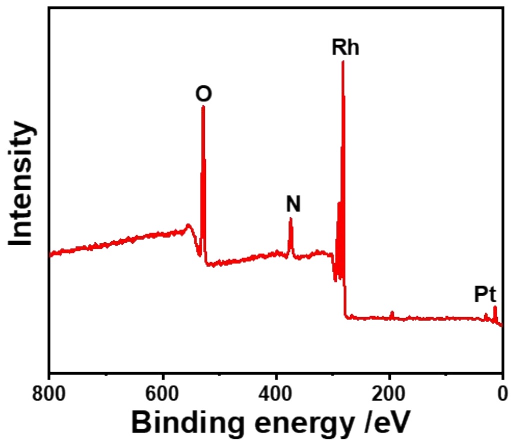

Fig. S18. Full XPS spectrum of $PtRh_{0.02}$@Rh NWs after long-time durability in the water.

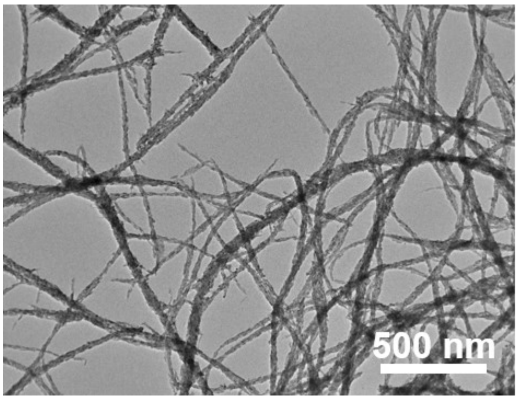

Fig. S19. TEM image of $PtRh_{0.02}$@Rh NWs after long-time durability in the water.

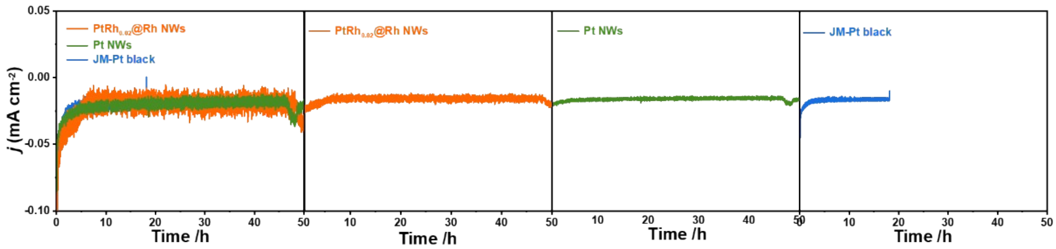

Fig. S20. The long-term stability tests of $PtRh_{0.02}$@Rh NW, Pt NW, and JM-Pt black at 10 mA cm^{-2} without iR compensation.

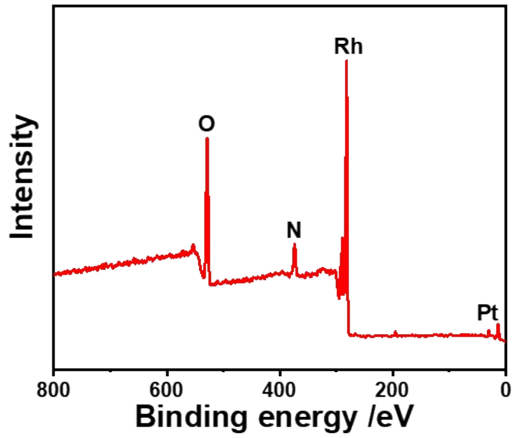

Fig. S21. Full XPS spectrum of $PtRh_{0.02}$@Rh NWs after long-time durability in the alkaline seawater.

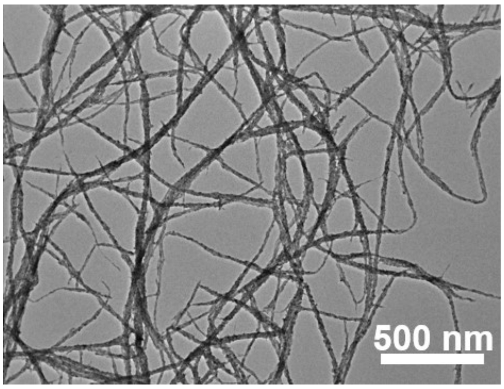

Fig. S22. TEM image of $PtRh_{0.02}$@Rh NWs after long-time durability in the alkaline seawater.

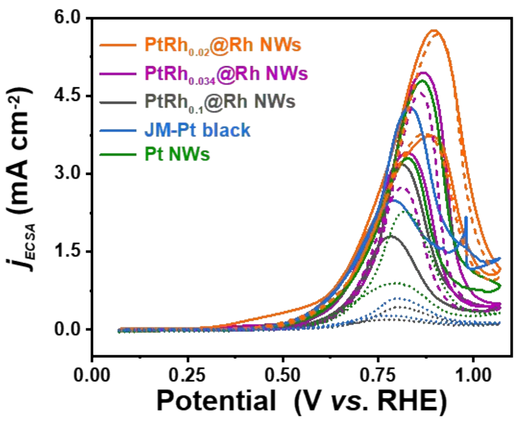

Fig. S23.The ECSA-normalized CV curves of $PtRh_{0.02}$@Rh NWs, $PtRh_{0.034}$ @Rh NWs, $PtRh_{0.1}$ @Rh NWs, Pt NWs, and Pt black in 0.1 M KOH and 0.5 M Ethylene glycol solution.

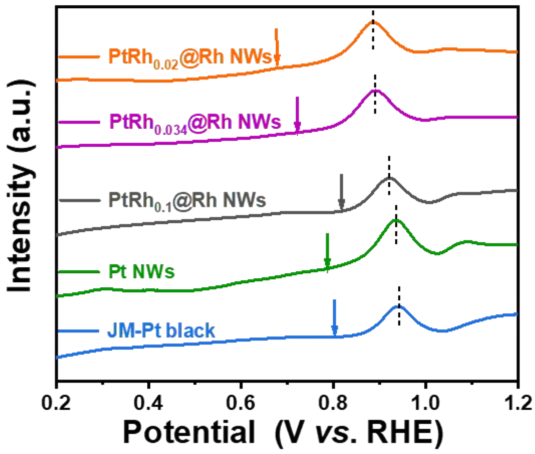

Fig. S24. CO stripping curves of $PtRh_{0.02}$@Rh NWs, $PtRh_{0.034}$@Rh NWs, $PtRh_{0.1}$@Rh NWs, Pt NWs, and JM-Pt black.

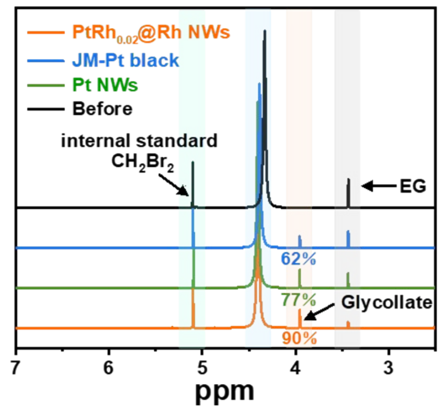

Fig. S25. The product was analyzed by 1H NMR using CH_2Br_2 (1 mmol) as the internal standard.1H NMR (500 MHz, DMSO-d6) spectra of compound glycollate.

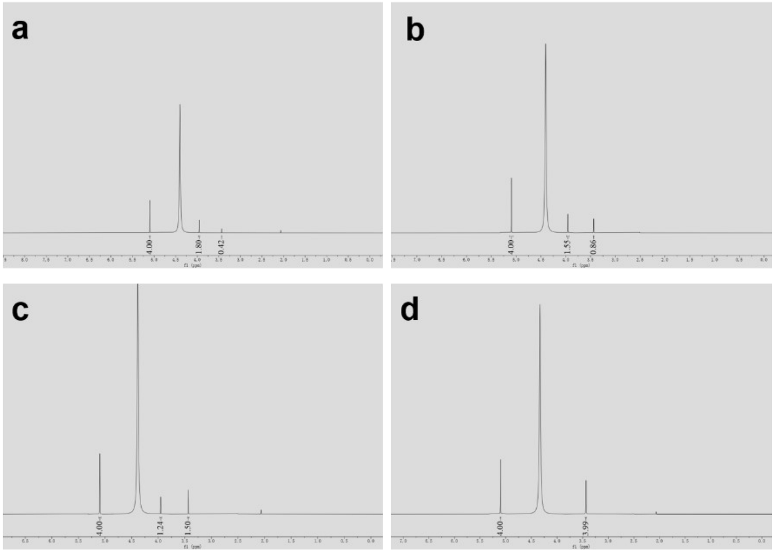

Fig. S26. The product was analyzed by 1H NMR using CH_2Br_2 (1 mmol) as the internal standard.1H NMR (500 MHz, DMSO-d6) spectra of compound glycollate. (a) $PtRh_{0.02}$@Rh NWs, (b) Pt NWs, (c) Pt black, and (d) without catalyst.

Table S1. The surface atomic ratio of Pt:Rh.

Component	Atomic conc. [%]	Error [%]	Mass conc. [%]	Error [%]
Rh 3d	8.84	0.30	17.84	0.36
Pt 4f	16.65	0.47	63.70	0.52