Supporting Information

Enhanced Electrocatalytic Activity of Ethanol Oxidation Reaction on Palladium-Silver Nanoparticles via Removable Surface Ligands

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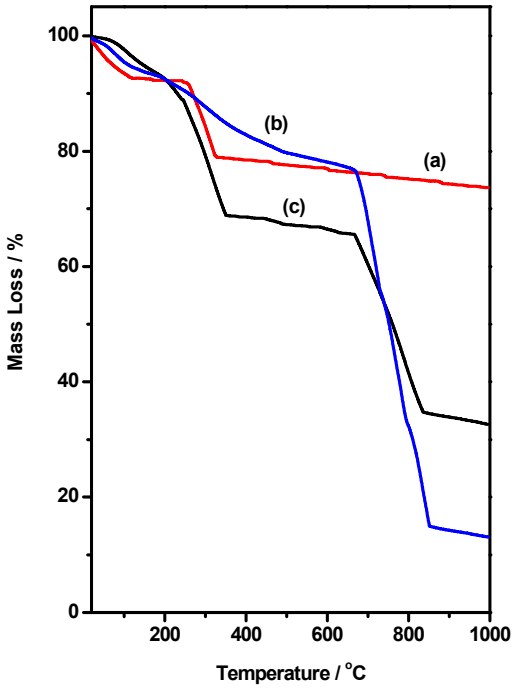

Figure S1. Curves of thermogravimetric analysis for Pd_1Ag_2@[C_2mim]BH_4 (a), amimRG (b), and Pd_1Ag_2@[C_2mim]BH_4-amimRG (c).

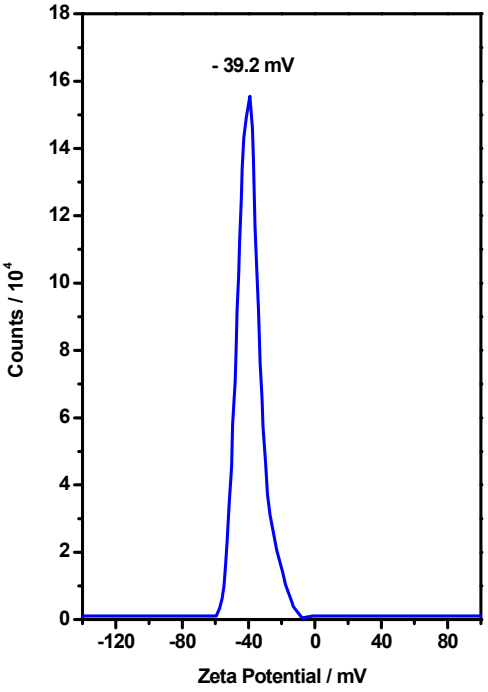

Figure S2. Zeta-potential of the as-prepared Pd_1Ag_2@[C_2mim]BH_4 NPs in aqueous solution.

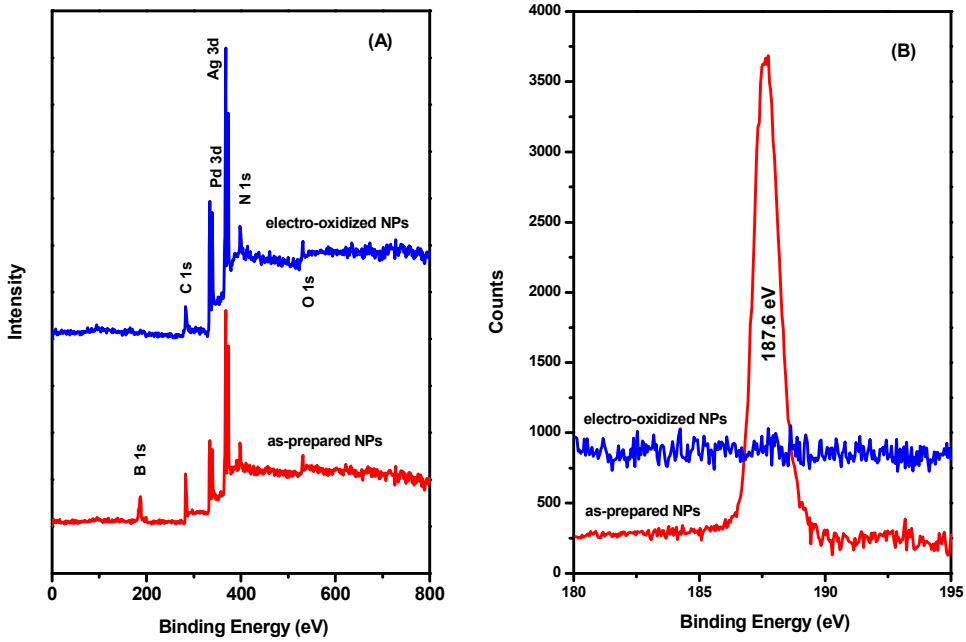

Figure S3. (A) XPS survey spectrum and (B) high-resolution XPS spectrum of B 1s before and after the electrooxidation of Pd_1Ag_2@[C_2mim]BH_4 NPs.

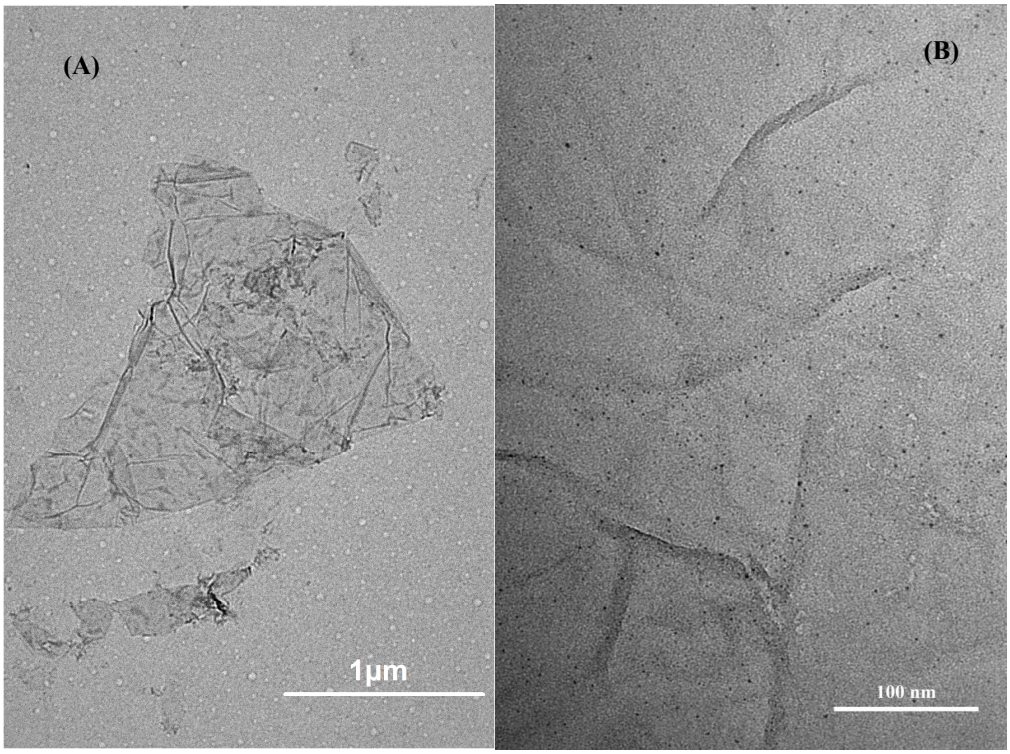

Figure S4. (A) TEM image of the as-prepared Pd_1Ag_2@[C_2mim]BH_4-amimRG nanocomposite. (B) TEM image that is magnified from the panel (A).

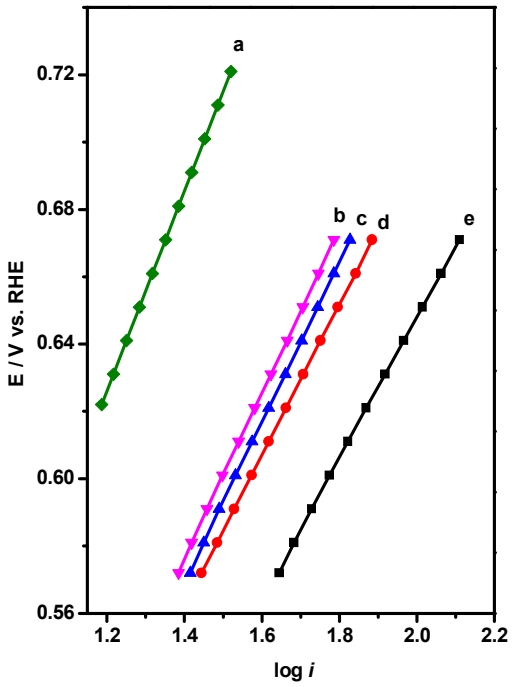

Figure S5. Tafel plot for the electrocatalysts in N_2-saturated 1 mol·L^{-1} KOH aqueous solution containing 1 mol·L^{-1} ethanol. Electrodes: Pd@[C_2mim]BH_4-amimRG/GCE (a), Pd_2Ag_1@[C_2mim]BH_4-amimRG/GCE (b), Pd_1Ag_1@ [C_2mim]BH_4-amimRG/GCE (c), Pd_1Ag_3@[C_2mim]BH_4-amimRG/GCE (d), and Pd_1Ag_2@[C_2mim]BH_4-amimRG/GCE (e).

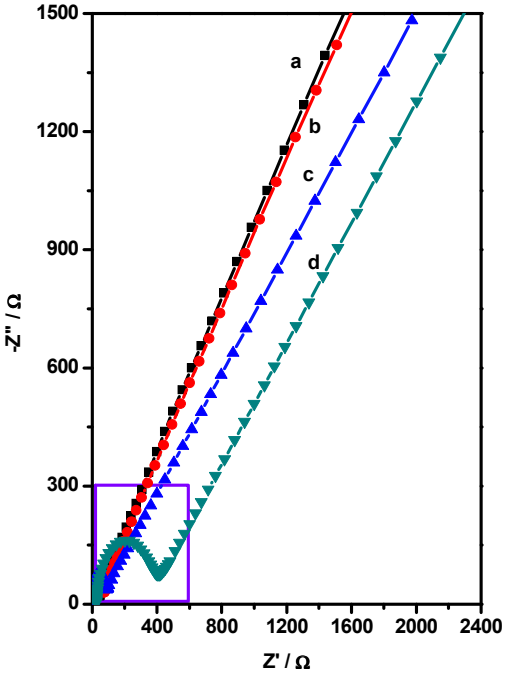

Figure S6. Nyquist diagrams of electrodes in 2.5 mmol·L^{-1} $[(Fe(CN)_6]^{3-}$/$[(Fe(CN)_6]^{4-}$ (1:1) solution containing 0.1 mol·L^{-1} KCl. Electrodes: Pd_1Ag_2@$[C_2mim]BH_4$-amimRG/GCE (a), Pd_1Ag_2@$[C_4mim]BH_4$-amimRG/GCE (b), Pd_1Ag_2@ $[C_6mim]BH_4$-amimRG/GCE (c), and amimRG/GCE (d).

Table S1. Comparison of the electrocatalyst performance for EOR in alkaline media.

Electrocatalyst*	Alcohol solution	E_{onset}	E_{peak}	i_{peak}	I_+/I_-	Ref.
FeCo@Fe@Pd/C	0.5 M EtOH/0.5 M KOH	−0.71 V (vs. Ag/AgCl)	0.14 V (vs Ag/AgCl)	214 mA mg^{-1}	1.24	(1)
THH Pd NCs	1 M EtOH/1 M NaOH	-0.52V (vs. SCE)	-0.2V (vs. SCE)	2.47 mA cm^{-2}	0.58	(2)
commercial Pd/C	1M EtOH/1M KOH	-0.6 V (vs. Ag/AgCl)	-0.23 V (vs Ag/AgCl)	25 mA mg^{-1}	0.8	(3)
Pd_{mw}/C	0.5 M EtOH/0.5 M KOH	–0.6V (vs. Ag/AgCl)	-0.18V (vs Ag/AgCl)	570 mA mg^{-1}	0.86	(4)
PdAg/GR	1M EtOH/1M KOH	−0.568V (vs. SHE)	0.229V(vs SHE)	940 mA cm^{-2} mg^{-1}	3.0	(5)
Pd_4Ag_1/C	1 M EtOH/1 M NaOH	-0.55V (vs. MMO)	-0.06V (vs MMO)	7.5 mA cm^{-2}	0.85	(6)
$Ag_{80}Pd_{20}$	1 M EtOH/1.0 M KOH	-0.45V (vs. MMO)	-0.118V (vs. MMO)	1.18 mA cm^{-2}	3.93	(7)
Pd_1Ag_2/[C_2mim]BH_4-amimRG	1.0M EtOH/1.0 M KOH	0.485V (vs RHE)	0.776V (vs RHE)	1509 mA cm^{-2} mg^{-1}	1.66	This Work

* C: carbon black; THH Pd NCs: tetrahexahedral Pd nanocrystals; Pd_{mw}: microwave activation of palladium nanoparticles; GR: graphene.

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