Electronic Supplementary Information (ESI)

Asymmetric Au-core Pd-shell Nanoparticles Supported on Reduced Graphene Oxide for Enhanced Electrocatalytic Activity

*Sungmin Noh, and Jun Ho Shim**

Department of Chemistry and Institute of Basic Science, Daegu University, Gyeongsan 38453, Republic of Korea

*Corresponding author: Fax: +82-53-850-6449; Tel: +82-53-850-6448

E-mail address: junhoshim@daegu.ac.kr (J. H. Shim)

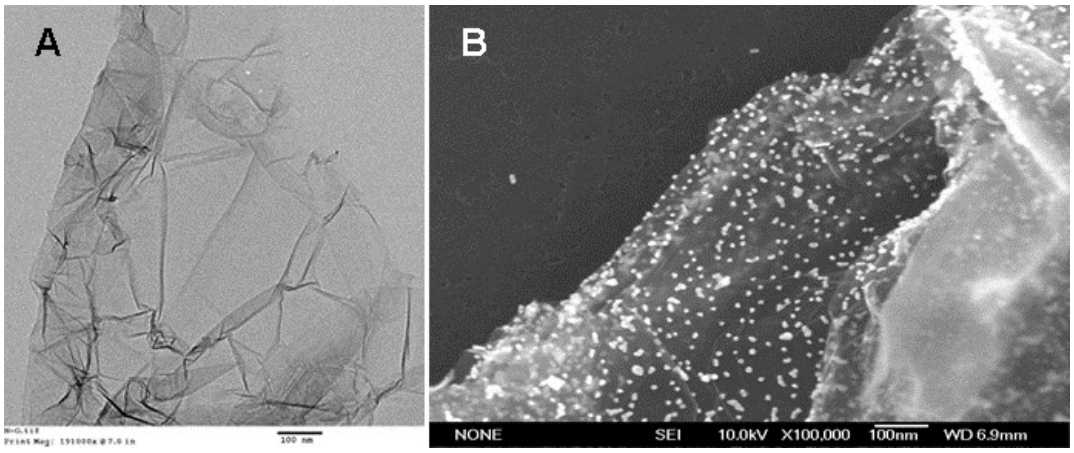

Fig. S1 Typical TEM and SEM images of the (A) rGO nanosheets and (B) $Au_{0.61}Pd_{0.39}$ nanoparticles supported on rGO, respectively.

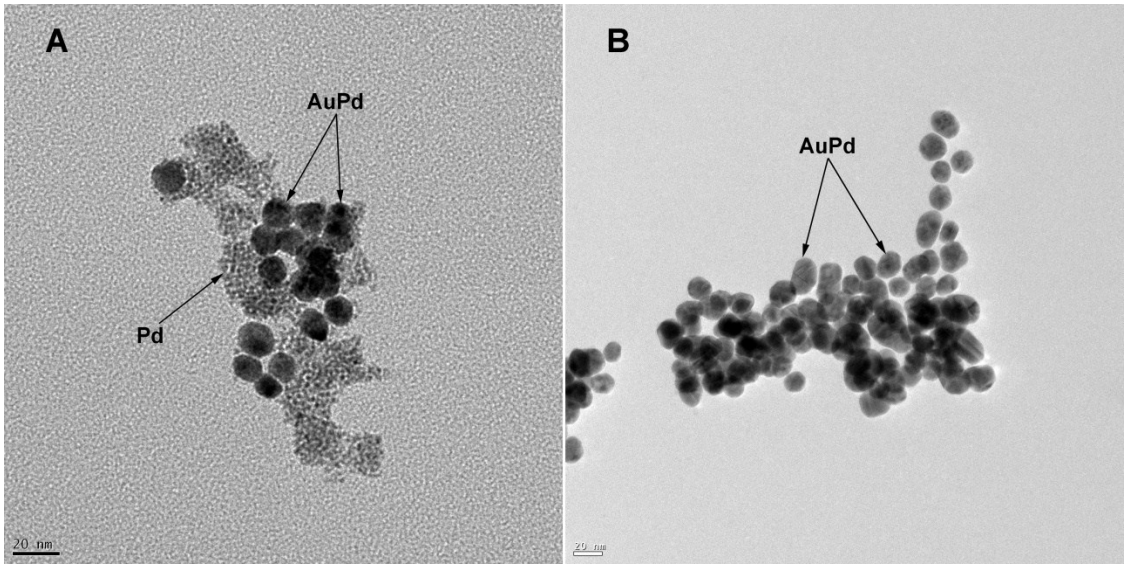

Fig. S2 Representative TEM images of (A) symmetric and (B) asymmetric AuPd nanoparticles obtained by adding a $PdCl_2$ solution to colloidal GNs and GNs-adsorbed glass substrate, respectively. The large isolated monometallic Pd nanoparticles synthesized by a spontaneous reduction reaction were not observed in the asymmetric AuPd catalysts.

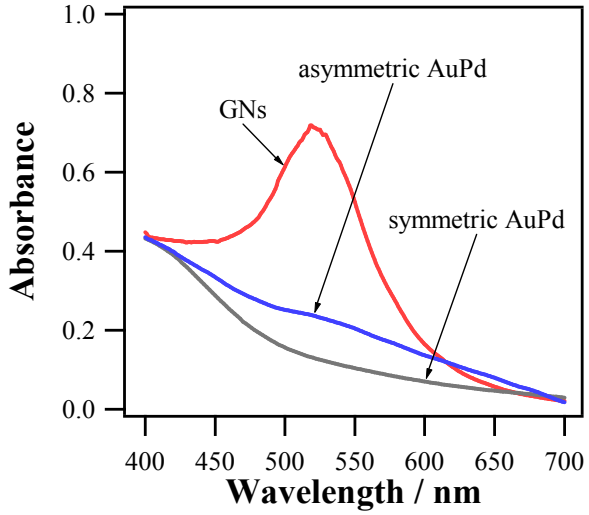

Fig. S3 UV-Vis spectra of GNs, symmetric and asymmetric AuPd nanoparticles. Both types of AuPd nanoparticles were synthesized using a 5.0 mM of $PdCl_2$ aqueous solution.

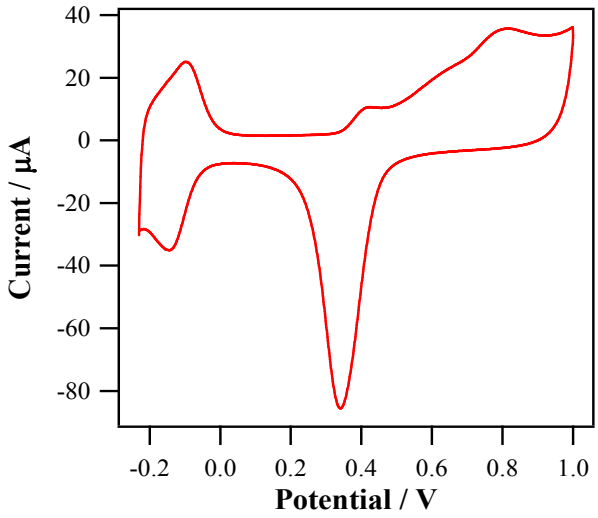

Fig. S4 Cyclic voltammogram obtained from Pd-20/C-modified GC electrode in the N_2-saturated 0.1 M $HClO_4$ solution at a scanning rate of 10 mV s^{-1}.

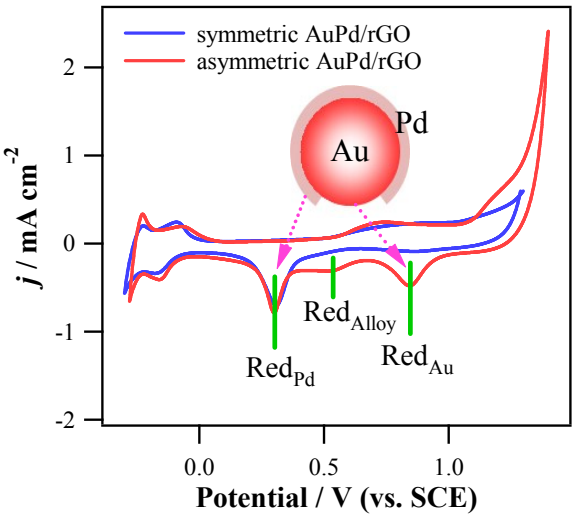

Fig. S5 Cyclic voltammogram obtained from symmetric AuPd/rGO or asymmetric AuPd/rGO-modified GC electrode in the N_2-saturated 0.1 M $HClO_4$ solution at a scanning rate of 50 mV s^{-1}. Both AuPd/rGO catalysts were synthesized with a 5.0 mM of $PdCl_2$ aqueous solution.

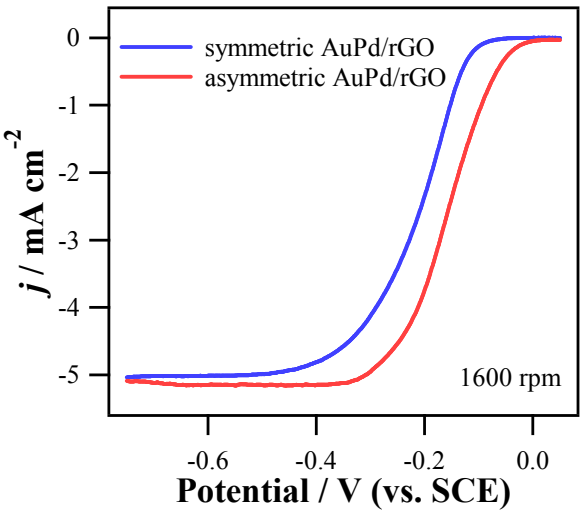

Fig. S6 RDE polarization curves for oxygen reduction in an O_2-saturated 0.1 M NaOH solution at a scan rate of 10 mV s^{-1} (rotation speed = 1600 rpm).

Table S1 Comparison of ICP-MS and XPS-derived elemental analyses for asymmetric Au-core Pd-shell nanoparticles.

$PdCl_2$ [mM]	ICP-MS		XPS	
	Au	Pd	Au	Pd
0	1.0	0.0	1.0	0.0
0.5	0.72	0.28	0.353	0.647
5	0.61	0.39	0.282	0.718
10	0.58	0.42	0.152	0.848