Supporting Information

Shape-Controlled Synthesis of Gallium-Palladium ($GaPd_2$) Nanocrystals as High-Performance Electrocatalysts for Hydrogen Evolution Reaction

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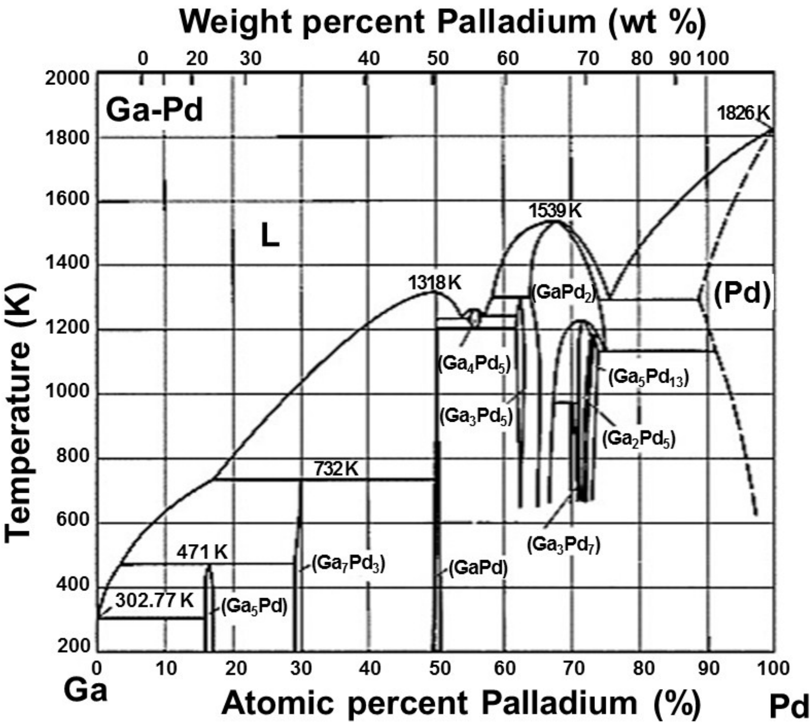

Fig. S1 Phase diagram of gallium and palladium.

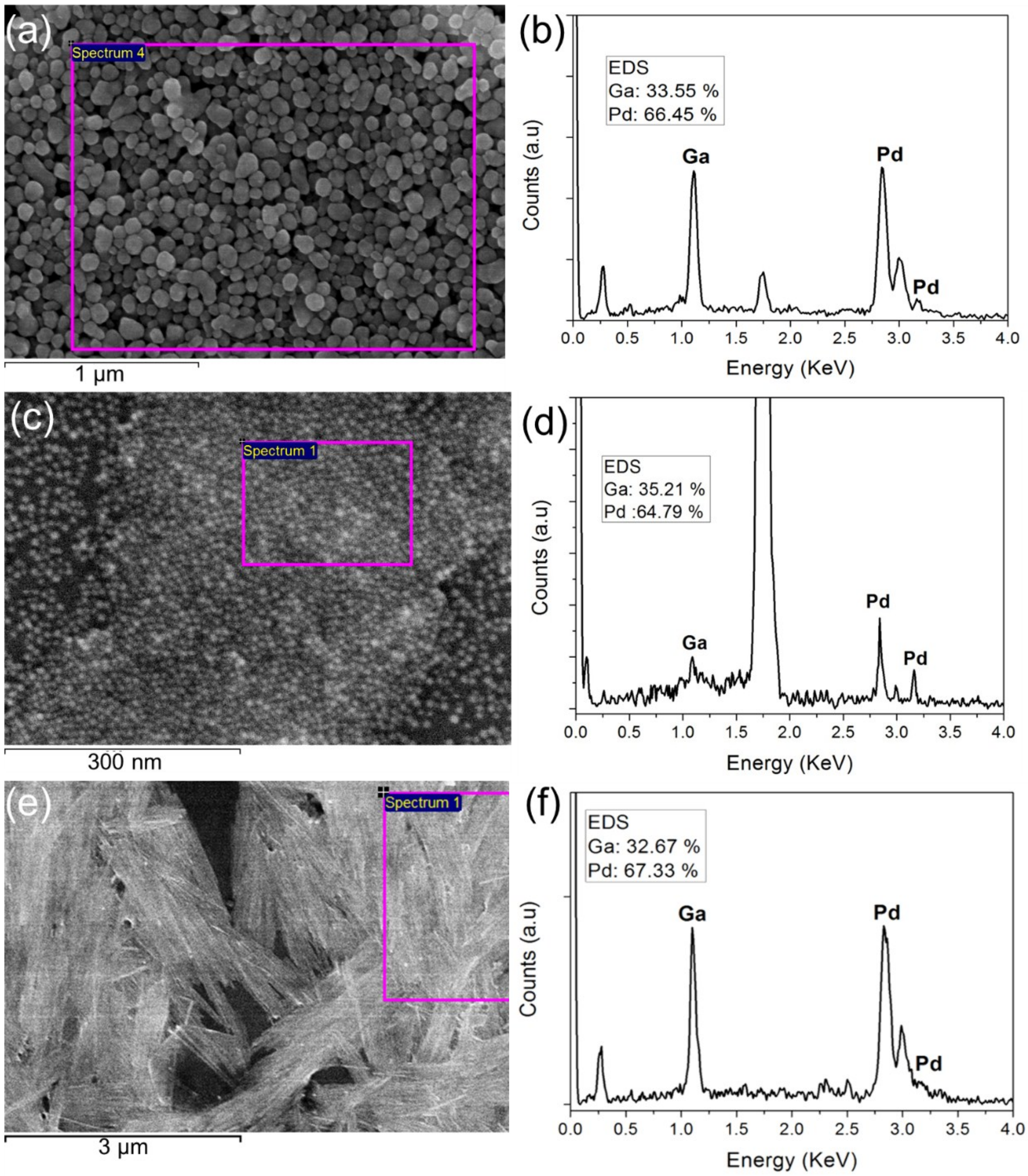

Fig. S2 Energy dispersive spectroscopy (EDS) analysis under SEM (a-b) $GaPd_2$ polyhedron (c-d) $GaPd_2$ nanoparticles (e-f) $GaPd_2$ nanowires

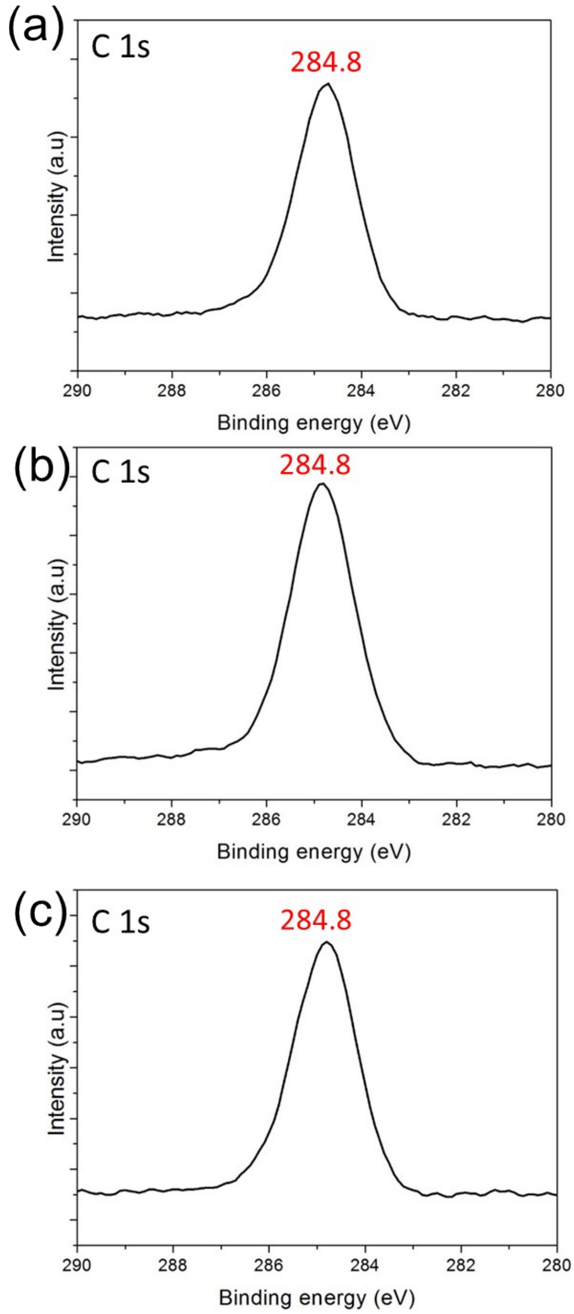

Fig. S3 XPS spectra C1s calibration of (a) $GaPd_2$ polyhedron (b) $GaPd_2$ nanoparticles (c) $GaPd_2$ nanowires

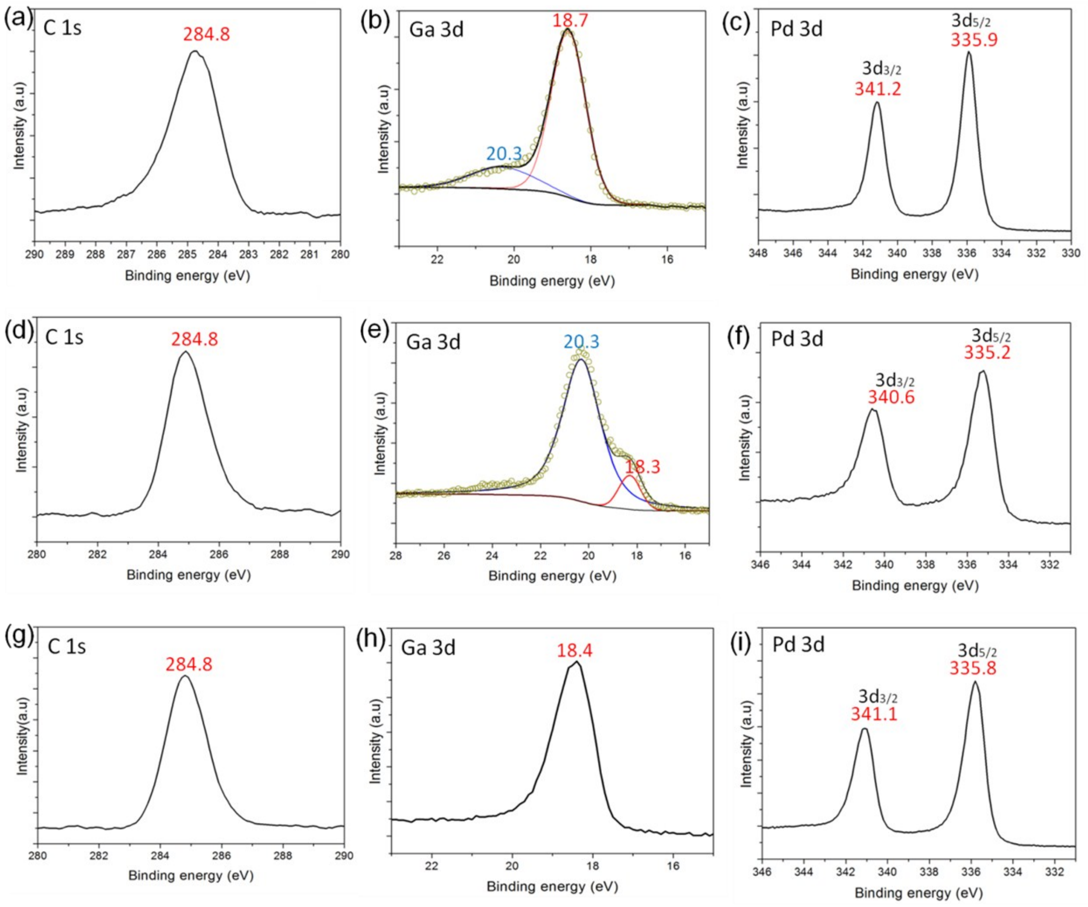

Fig. S4 XPS spectra of $GaPd_2$ nanomaterials (data obtained after 2 weeks of samples preparation) (a-c) $GaPd_2$ polyhedral nanocrystals (d-f) $GaPd_2$ nanoparticles (g-i) $GaPd_2$ nanowires

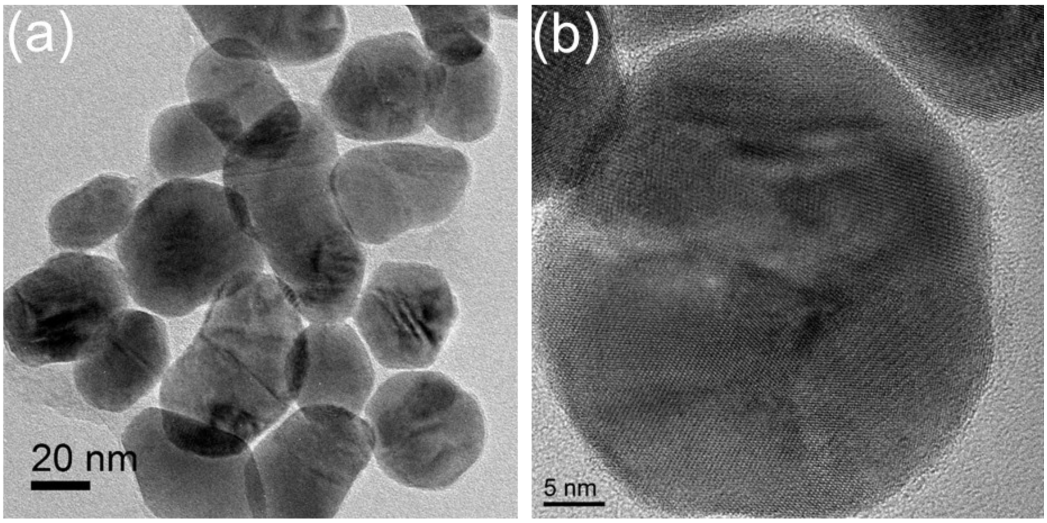

Fig. S5 (a-b) The polyhedral $GaPd_2$ nanocrystals TEM images

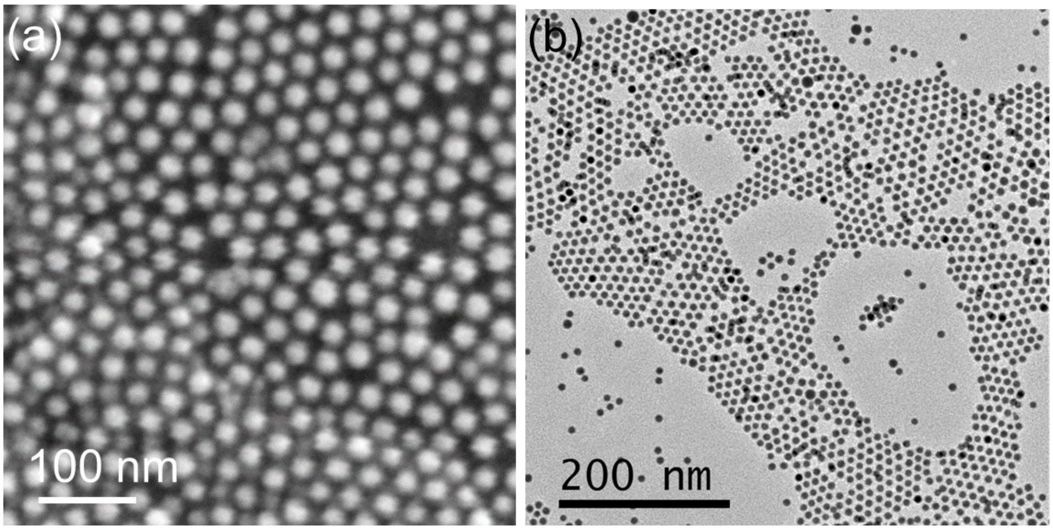

Fig. S6 (a) The $GaPd_2$ nanoparticles SEM image (b) TEM image

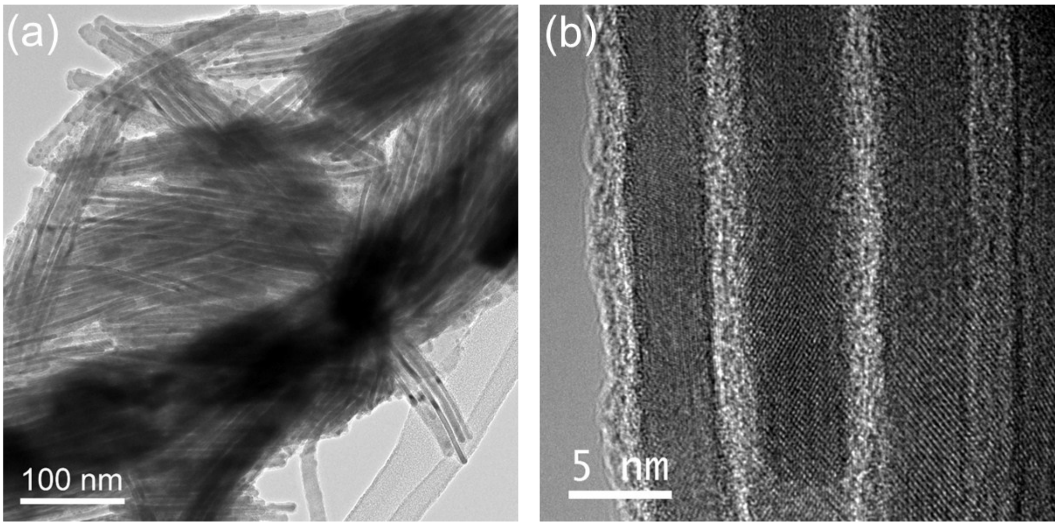

Fig. S7 (a-b) The $GaPd_2$ nanowires TEM images

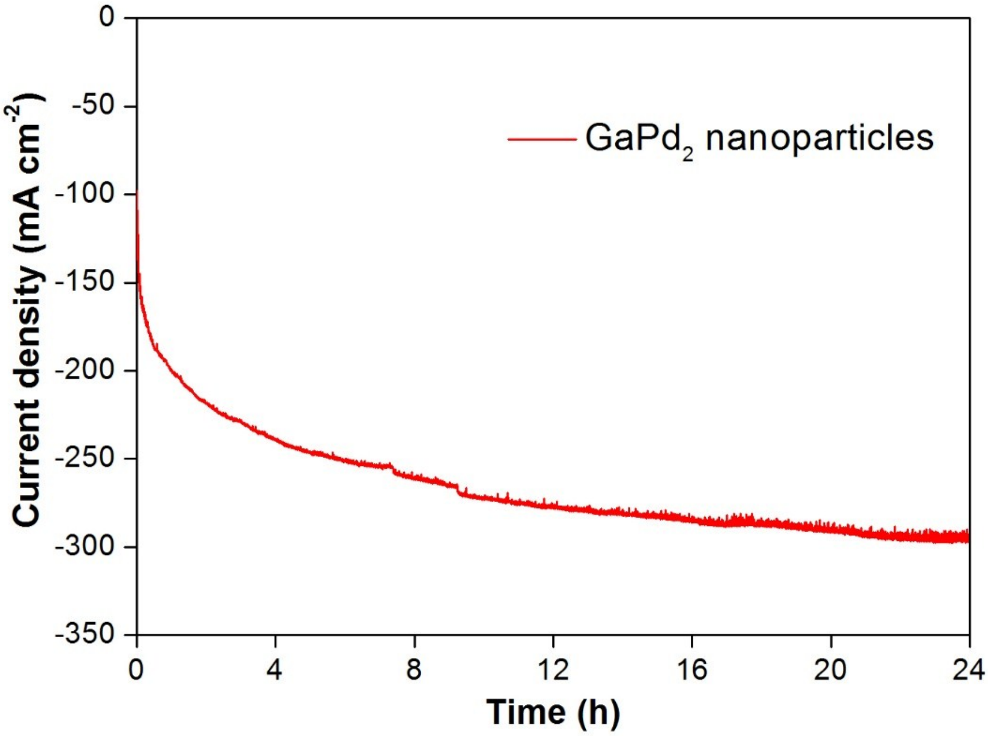

Fig. S8 The pre *i-t* testing of $GaPd_2$ nanoparticles with applied voltage of -0.5 V *vs*. RHE over 24 hours in 0.5 M H_2SO_4 electrolyte

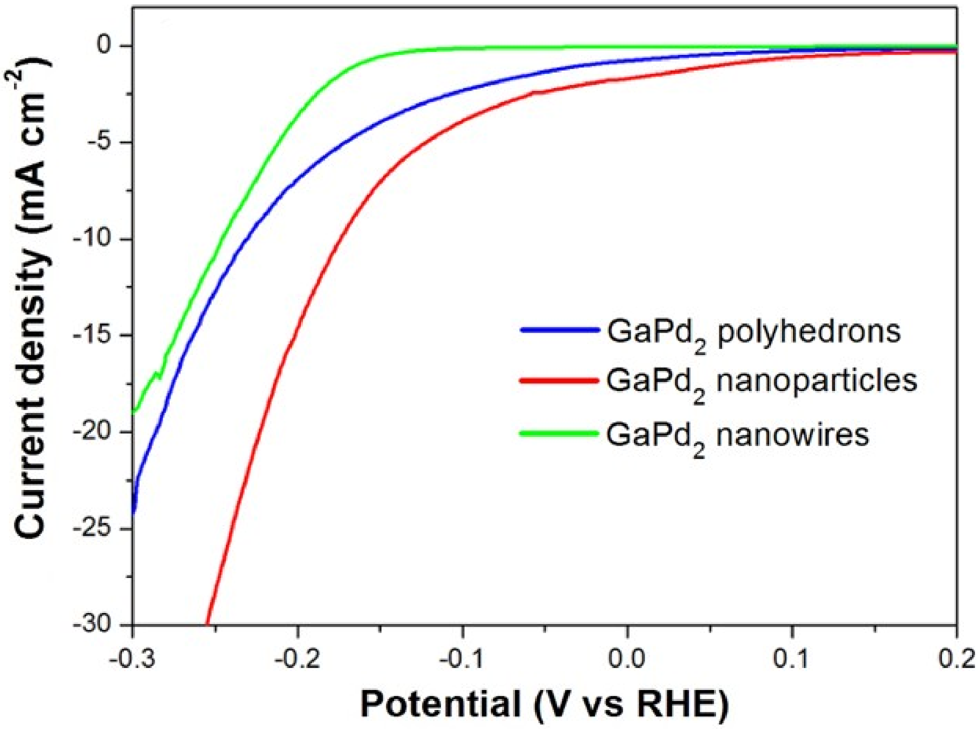

Fig. S9 Representative polarization curves of $GaPd_2$ polyhedrons, $GaPd_2$ nanoparticles and $GaPd_2$ nanowire working electrodes in 0.5 M H_2SO_4 solution before pre *i-t* testing for 24 hours

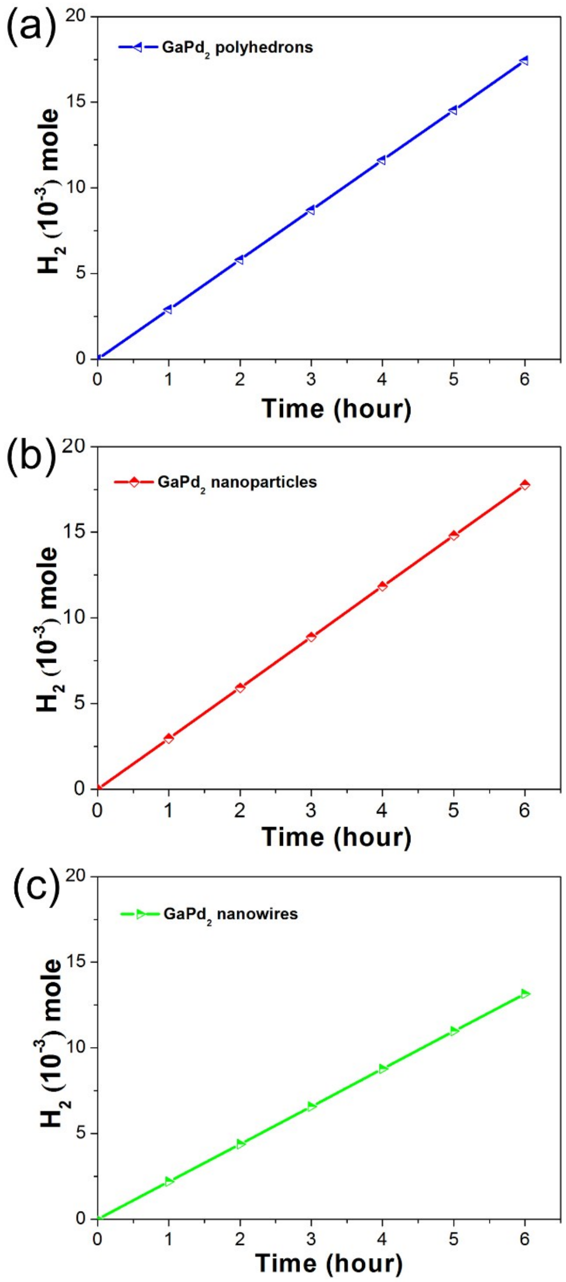

Fig. S10 Theoretical hydrogen production versus time for $GaPd_2$ (a) polyhedrons (b) nanoparticles (c) nanowires at a constant voltage of 800 mV for 6 hours”

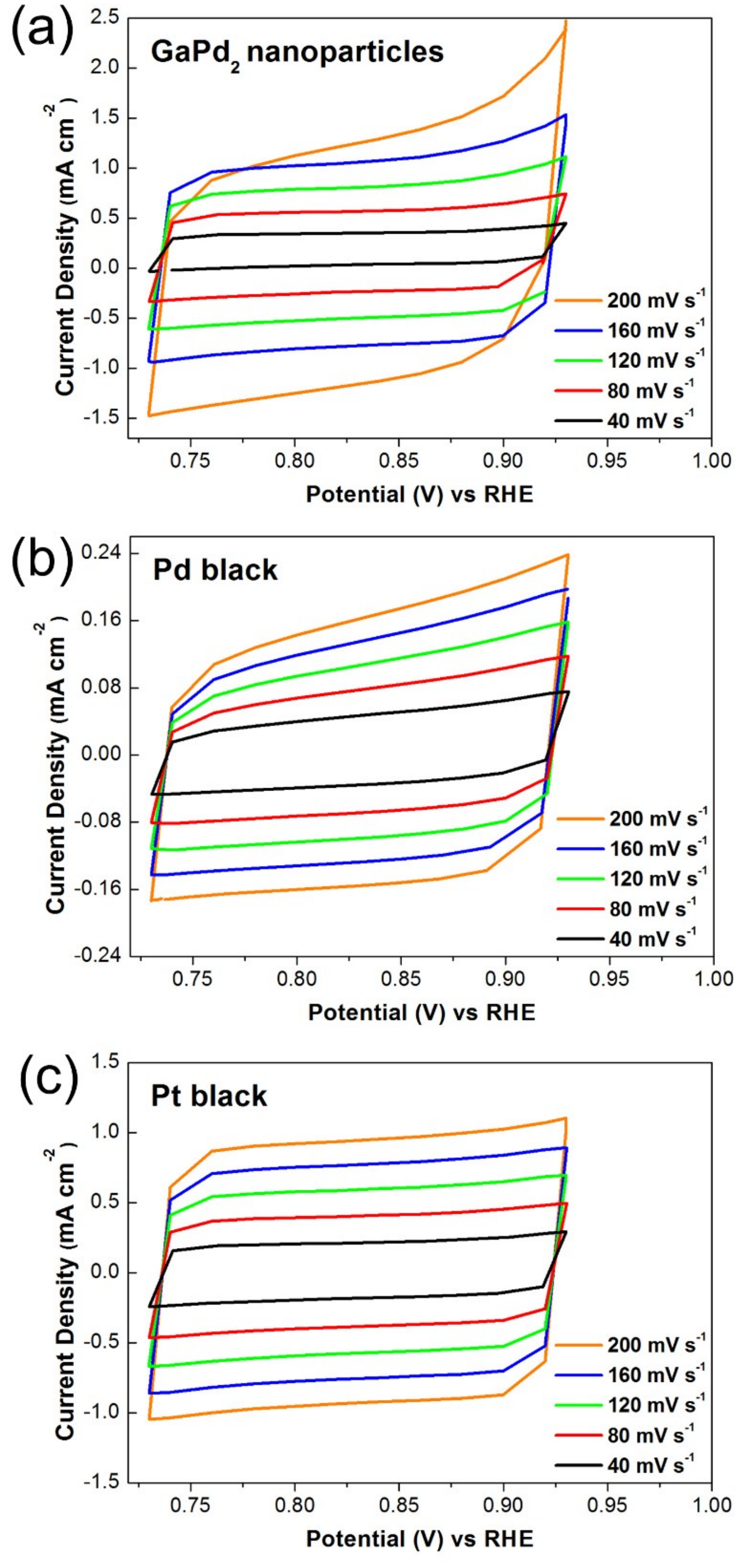

Fig. S11 (a) $GaPd_2$ (b) Pd black (c) Pt black at various scan rates (40, 80, 120, 160, 200 mV/s) in the region of 0.73-0.93 V vs RHE

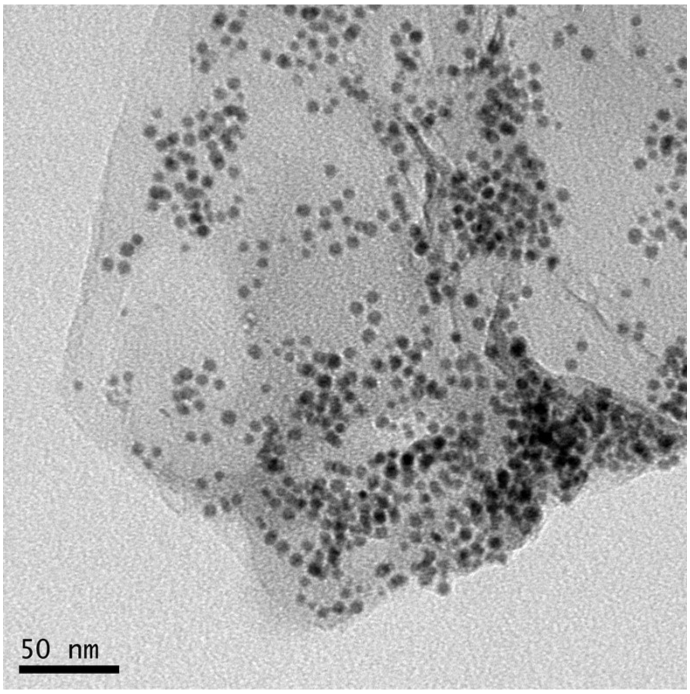

Fig. S12 Representative TEM image of $Gapd_2$ nanoparticles loaded on reduced graphene oxide (rGO).

Table S1 Comparison of HER activity for the $GaPd_2$ electrocatalyst with other recently reported Pd-based highly efficient electrocatalyst in acidic media.

Catalyst	Electrolyte	Mass loading ($\mu g\ cm^{-2}$)	Overpotential @10 mA/cm^2 (mV)	Tafel slope ($mV\ dec^{-1}$)	J_0 ($mA\ cm^{-2}$)	IR correction	Ref.
$GaPd_2$ polyhedrons	0.5 M H_2SO_4	300	33.2	55.2	2.67	No	This work
$GaPd_2$ nanoparticles			24.3	49	2.69		
$GaPd_2$ nanowires			50.1	57.2	0.96		
$GaPd_2$/rGO			31.5	48.3	1.80		
PdNP@N-CNTs	0.5 M H_2SO_4	285	46.8[a]	33	--	--	1
Porous Pd NP assemblies	0.5 M H_2SO_4	280	37.5[a]	30	0.24	--	2
Pd/graphene	0.5 M H_2SO_4	445	84	46	--	--	3
Ni@Pd_4:1/PEI–$rGO_{50:1}$ (10 wt%)	0.5 M H_2SO_4	140	59	54	3.91	--	4
AgPd	0.1 M H_2SO_4	--	151[a]	156	0.0126	--	5
porous Pd-CNx	0.5 M H_2SO_4	43(Pd)	55	35	0.4	--	6
Pd cube/PEI-$rGO_{50:1}$(10 wt. %)	0.5 M H_2SO_4	140	38[a]	34	2.29	Yes	7
PdMnCo/NC	0.5 M H_2SO_4	285	39	31	--	--	8
PdCu	0.5 M H_2SO_4	76.65	56	51	--	--	9
$PdCu_3$	0.5 M H_2SO_4	280	50[a]	34	0.18	--	10
$Pd_{71}Cu_{29}$/C	0.1 M H_2SO_4	100	75	48	0.38	Yes	11
$Pd_{3.02}$Te NWs /rGO	0.5 M H_2SO_4	285	43[a]	90	--	--	12
rGO-PdPS	0.5 M H_2SO_4	250	90[a]	46	--	--	13
Pd_4Se	0.5 M H_2SO_4	--	94[a]	50	0.23	Yes	14

Note: [a] The numerical value is calculated from the figure in the reference.

Reference

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