Supplementary Materials

Simple Synthesis of Ultrasmall Pt_5La Nanoalloy for Highly Efficient Oxygen Reduction Reaction

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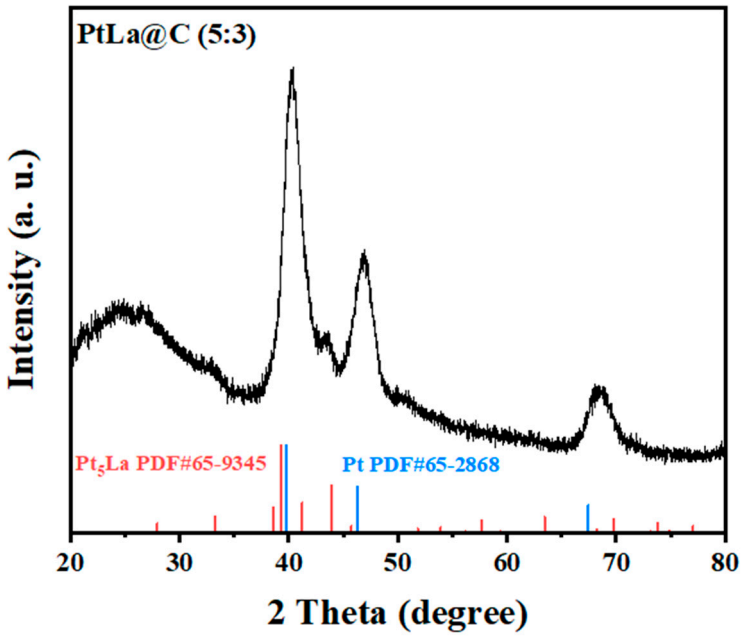


Figure S1. XRD pattern of PtLa@C sample synthesized with Pt and La atomic ratio of 5:3 (PtLa@C (5:3)) before leaching.

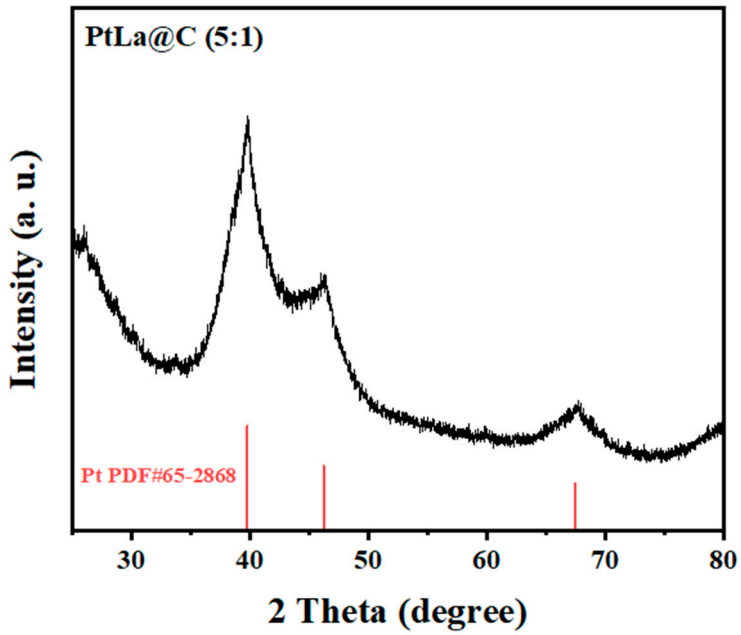


Figure S2. XRD pattern of PtLa@C sample synthesized with Pt and La atomic ratio of 5:1 (PtLa@C (5:1)).

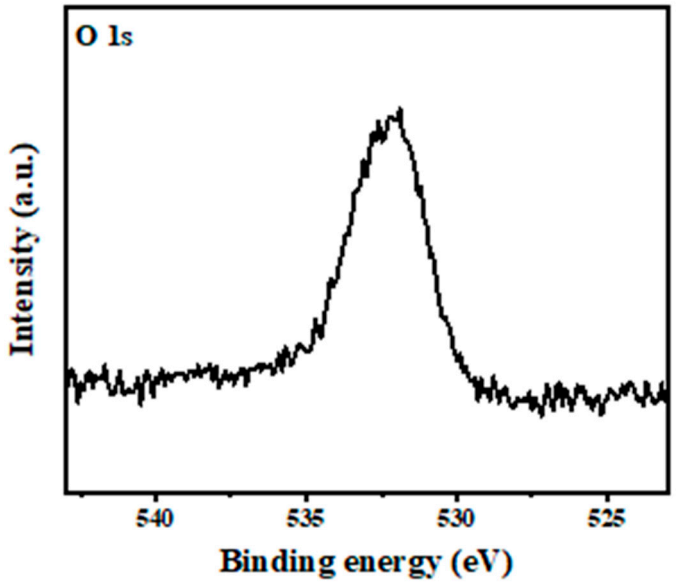


Figure S3. O 1s XPS spectra of Pt_5La@C sample after acid leaching.

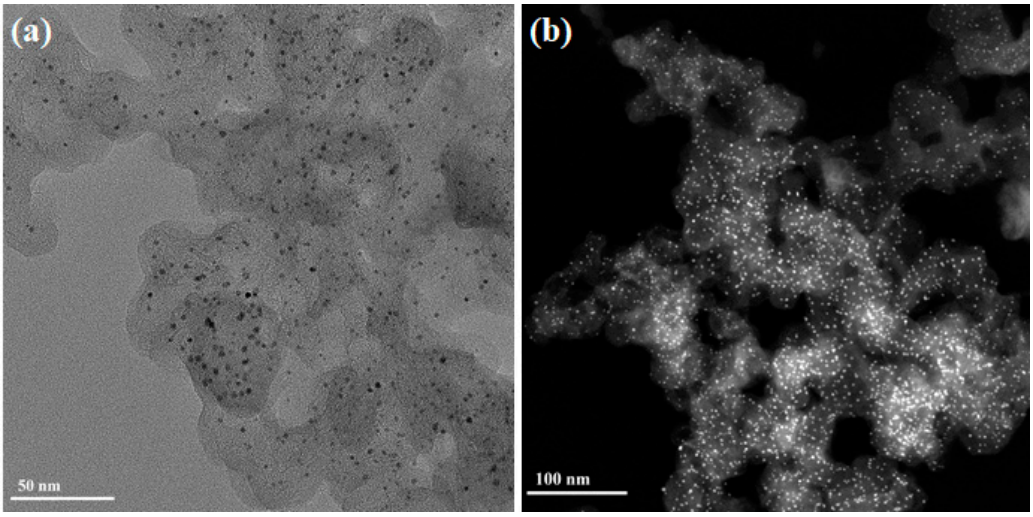


Figure S4. (a) TEM and (b) HAADF-STEM images of Pt_5La@C sample;

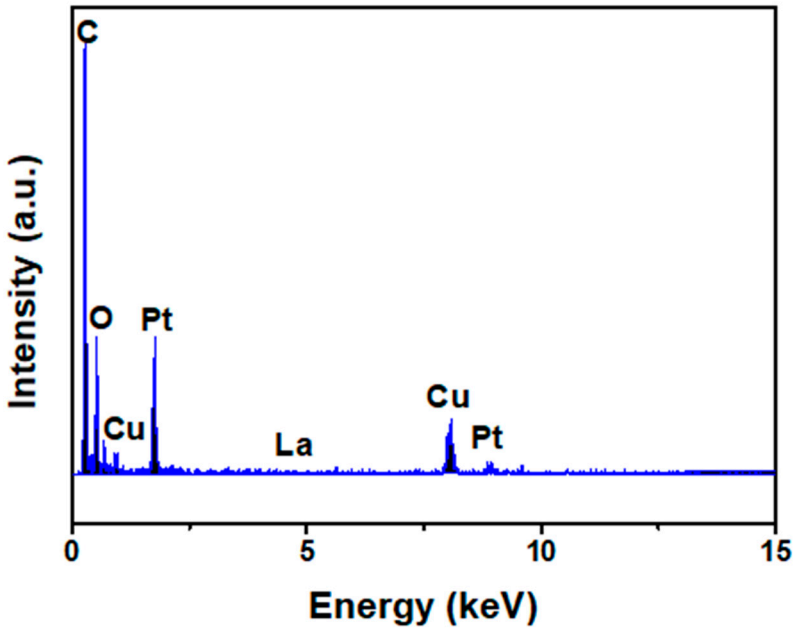


Figure S5. TEM-EDS spectrum of Pt_5La@C sample.

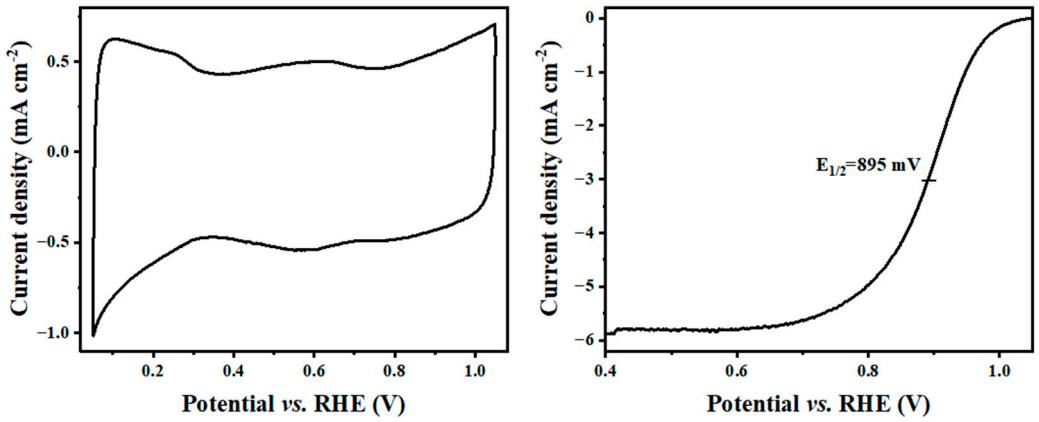


Figure S6. (a) Cyclic voltammetry curve, (b) ORR polarization curve of Pt_5La@C sample before acid leaching (PtLa@C (5:5)).

Table S1. Chemical composition of Pt_5La@C sample after acid leaching.

Element	Theoretical content (wt.%)	By ICP-MS (wt.%)
Pt	10.32%	10.37%
La	1.47%	0.85%

Table S2. Atomic ratios of Pt, La, C and O species in Pt_5La@C sample after leaching detected by XPS.

Sample	Pt (at%)	La (at%)	C (at%)	O (at%)
Pt_5La@C	0.5	0.1	95.3	4.2

(at%: atomic ratio)

Table S3. Binding energies and atomic ratios of Pt specie in Pt_5La@C sample after acid leaching.

Sample	Pt^0 BE (eV)	at% (%)	Pt^{2+} BE (eV)	at% (%)
Pt_5La@C	71.6/74.9	68.5%	73.1/76.4	31.5%

(BE: binding energy, at%: atomic ratio)

Table S4. Comparison of ORR performance for various Pt-RE alloys catalysts under acidic conditions.

No.	Catalysts	MA ($A\ mg_{pt}^{-1}$)	$E_{1/2}$ (mV)	SA ($mA\ cm^{-2}$)	Refs.
1	**Pt_5La@C**	**0.42**	**912**	**0.69**	**This work**
2	Pt_5La	0.49	920	0.47	[1]
3	PtLa/C	0.44	872	1.88	[2]
4	O-Pt_5La	0.66	-	1.39	[3]
5	d-Pt_5La	0.18	-	0.27	[3]
6	Pt_5La/C 700 °C	0.11	861	0.53	[4]
7	Pt_5La/XC-72	~0.5	-	~0.8	[5]
8	Pt-Pt_5La/C	~0.22	900	~0.35	[6]
9	Pt_2Nd/C	0.26	886	1.11	[7]
10	Pt_5Nd/C	0.41	902	1.44	[7]
11	Pt_5Nd	0.39	899	1.47	[7]
12	PtDy/C	0.77	901	2.92	[2]
13	Pt_xY/CV	0.59	-	1.41	[8]
14	Pt_xY/KB300	0.62	-	1.01	[8]
15	Pt_xY/KB600	0.32	-	0.47	[8]
16	Pt_1Dy_2/C	0.431	820	14.5	[9]
17	Pt_1Dy_1/C	0.594	860	13.2	[9]
18	Pt_3Dy_1/C	0.394	850	6	[9]
19	Pt_5Dy_1/C	0.288	820	6.6	[9]
20	Pt_2Gd/HMCS	0.31	900	0.71	[10]
21	Pt_2Gd	1.5	950	0.9	[11]
22	Pt_3Gd/C	0.26	860	0.61	[12]

References:

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