Supporting Information

Highly simple and rapid synthesis of ultrathin gold nanowires with (111)-dominant facets and enhanced electrocatalytic properties

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Experimental

Materials and reagents

α-naphthol ($C_{10}H_8O$) was purchased from Aladdin (Shanghai, China). Chloroauric acid ($HAuCl_4$) was supplied by Shanghai Dibo Chemical Technology Co., Ltd. (Shanghai, China). Ethanol (C_2H_5OH) was provided by Sinopharm Chemical Reagent Co. Ltd. (Shanghai, China). Deionized water was used throughout the experiments. All chemicals were of analytical reagent grade and used as received without further purification.

Characterizations

Transmission electron microscopy (TEM) and high-resolution TEM (HRTEM) were performed on a JEOL JEM-2100F transmission electron microscopy operated at an accelerating voltage of 200 kV. Scanning electron microscopy (SEM) images and energy-dispersive X-ray (EDX) spectrum were acquired on a Hitachi S5500 SEM. X-ray diffraction (XRD) patterns of the samples were determined by a Model D/max-rC X-ray diffractometer using Cu Kα radiation source (λ=1.5406 Å) and operating at 40 kV and 100 mA. X-ray photoelectron spectroscopy (XPS) measurements were carried out with a Thermo VG Scientific ESCALAB 250 spectrometer with a monochromatic Al Kα X-ray source. The binding energy was calibrated by means of the C1s peak energy of 284.6 eV. Thermogravimetric analyses (TGA) of the samples were conducted on a Perkin-Elmer thermal analysis system at a heating rate of 10 °C min^{-1} under oxygen atmosphere.

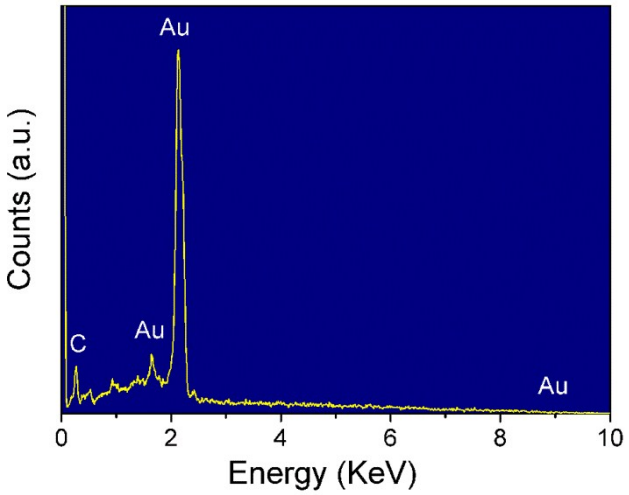

Fig. S1 EDX spectrum of the resultant Au nanowires.

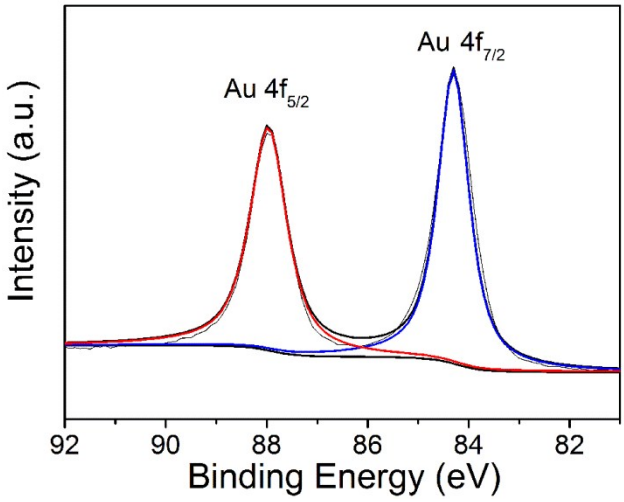

Fig. S2 XPS spectrum of Au 4f region for the obtained Au nanowires.

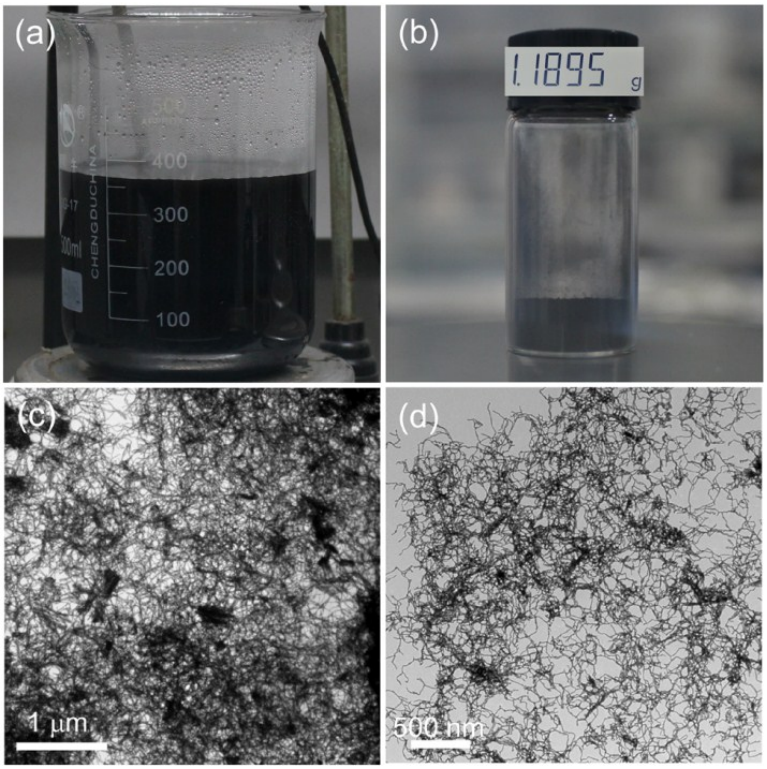

Fig. S3 (a and b) Digital photos showing the large-scale synthesis of Au nanowires from a single batch, and (c and d) TEM images of the Au nanowires from large-scale synthesis.

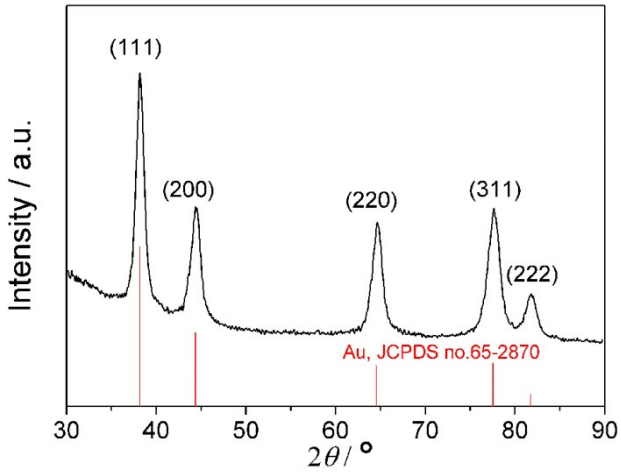

Fig. S4 XRD pattern of the product collected upon the mixing of $HAuCl_4$ and α-naphthol solutions, suggesting the rapid formation of metallic Au.

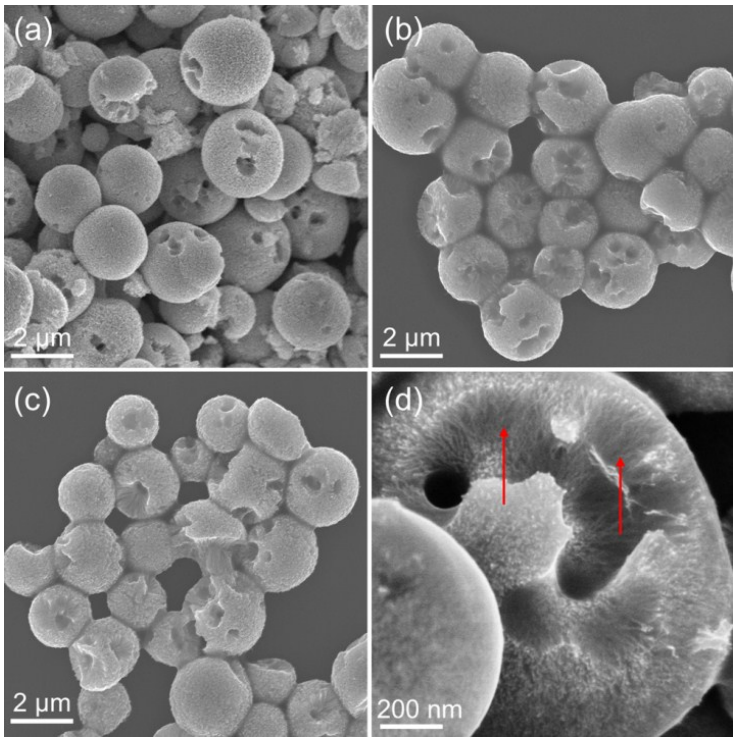

Fig. S5 SEM images of the obtained Au nanowire-arrayed microspheres synthesized at different reaction temperatures. (a) 20 °C, (b) 40 °C, (c) 20 °C, and (d) magnified SEM image showing the arrayed structure of the Au microsphere.

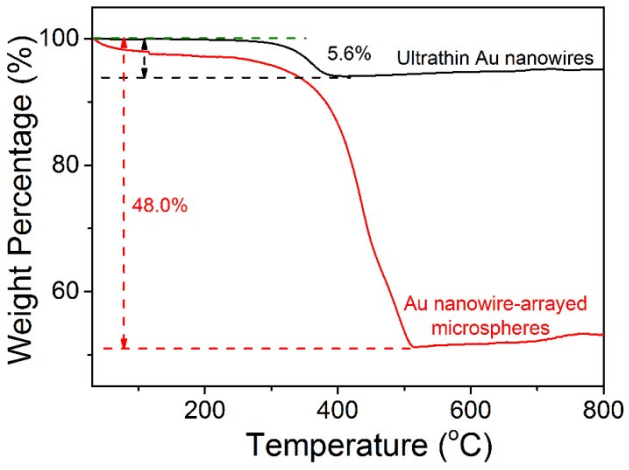

Fig. S6 TGA curves of the as-prepared Au nanowire-arrayed microspheres and Au nanowires.

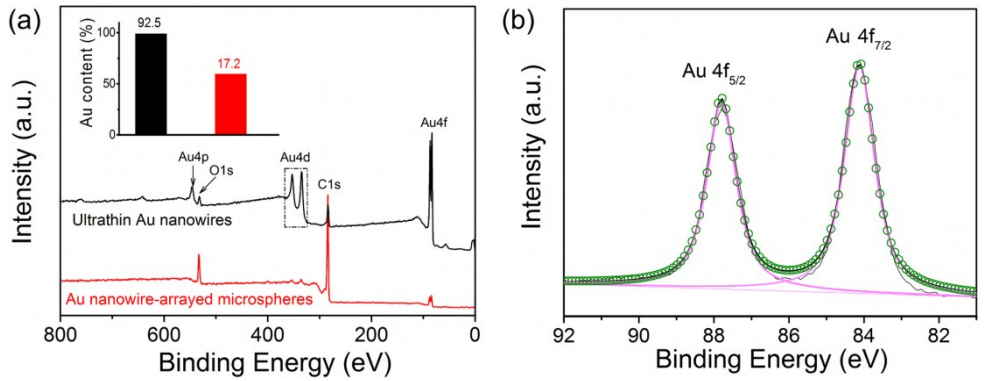

Fig. S7 XPS spectra of the Au nanowire-arrayed microspheres and final Au nanowires. (a) survey spectra of the two samples and (b) Au 4f region for the Au nanowire-arrayed microspheres.

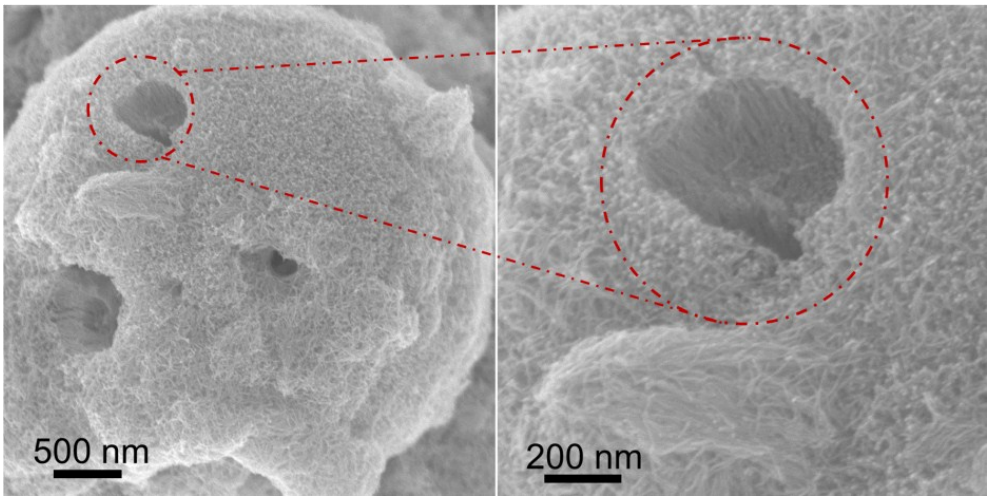

Fig. S8 SEM images of the re-assembled Au nanowire arrays obtained by dispersing disordered Au nanowires in α-naphthol ethanol solution.

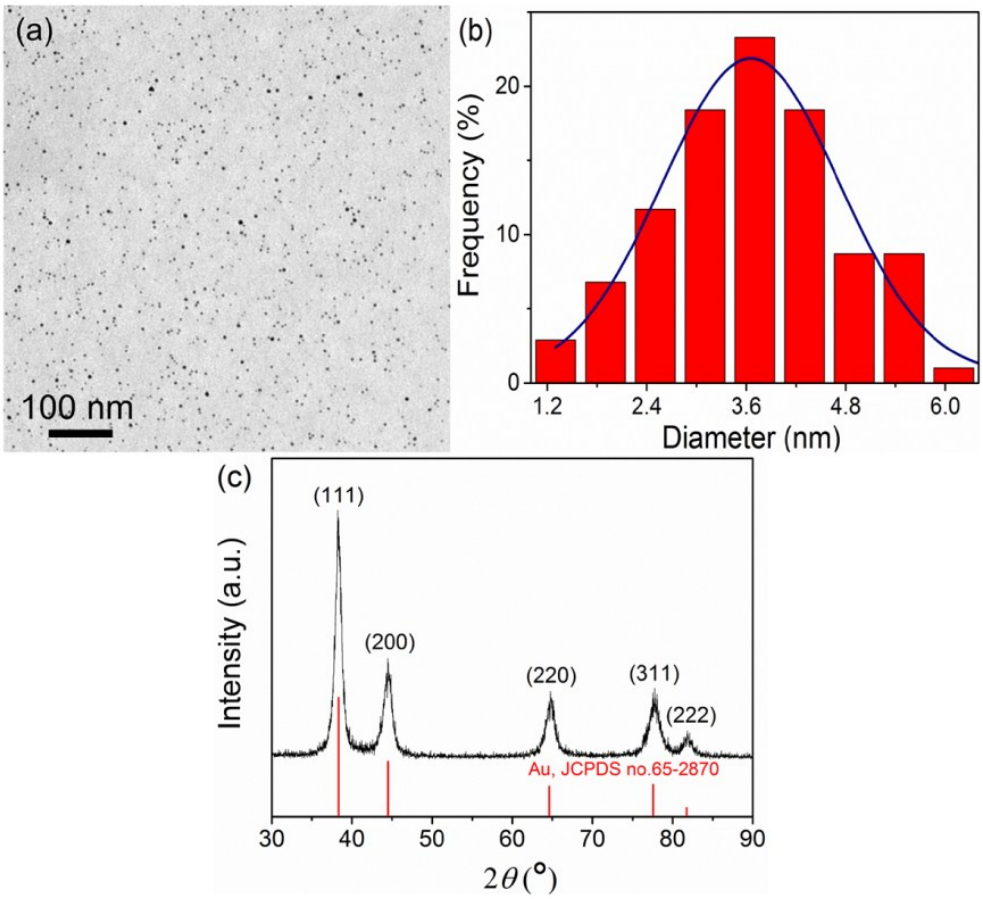

Fig. S9 (a) TEM image, (b) corresponding size distribution and (c) XRD pattern of the Au nanoparticles synthesized according to the literature.[1,2]

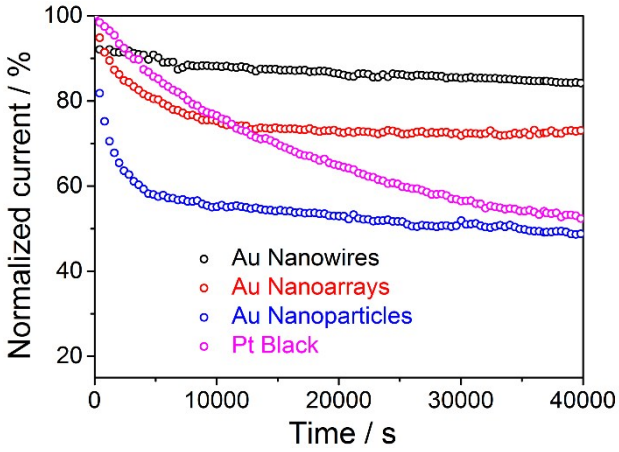

Fig. S10 Chronoamperometric measurements of four catalysts at 0.5 V in O_2-saturated 0.1 M KOH.

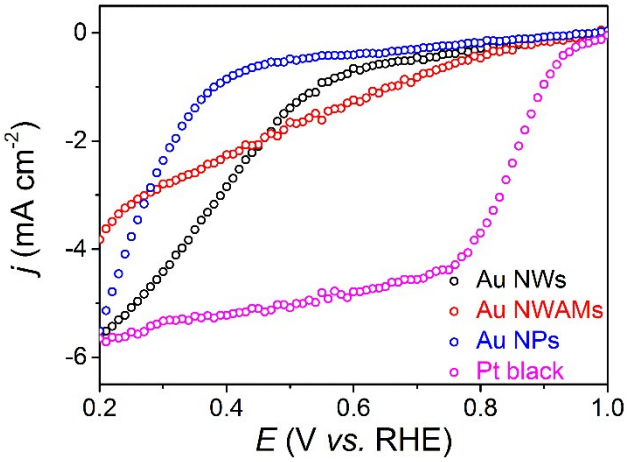

Fig. S11 ORR LSV curves of the catalysts recorded in O_2-saturated 0.1 M $HClO_4$ solution.

Table S1 Comparison of the synthetic method of the Au nanowires in this work with other Au nanowires reported before.

Number	Solvent	$T^{(a)}$ / °C	$t^{(b)}$	$l^{(c)}$ / nm	$d^{(d)}$ / nm	Ref
1	**water + ethanol**	**60**	**~1 min**	**>1000**	**4.6**	**this work**
2	hexane	R.T.[(e)]	>48 h	-	~1.0	[3]
3	-	1100	30 min	280-740	80-125	[4]
4	triisopropylsilane	R.T.	4-5 h	>1000	1.6	[5]
5	oleylamine + trichloromethane	35	>5 days	10-3500	1.6	[6]
6	water + toluene	R.T.	>1 h	>1000	~5	[7]
7	toluene	55	8 h	>1000	2	[8]
8	water	37	48 h	>1000	13.1	[9]
9	water	R.T.	24 h	100000	15	[10]
10	water	R.T.	>12 h	10000	~31.5	[11]
11	oleylamine + oleic acid	80	5 h	>1000	3 or 9	[12]
12	hexane	60	24-100 h	2000	1.8	[13]
13	water	30	1-72 h	>1000	45.3	[14]
14	water + dichloromethane	R.T.	72 h	~500	~20	[15]
15	water + toluene	R.T.	>24 h	<500	<5.0	[16]
16	water	25	-	<1000	30	[17]
17	water + toluene	R.T.	1 h	<1000	5	[18]
18	water	180 & 25	8 h	>1000	22	[19]
19	n-hexane	30	>3 h	-	2	[20]
20	hexane + oleylamine	R.T.	>36 h	500	2	[21]
21	water	R.T.	30 min	650	15	[22]
22	water	R.T.	1 h	1000	40-65	[23]
23	water + ethanol	R.T.	>2 h	>1000	6	[24]
24	water	R.T.	>52 h	>1000	28-47	[25]
25	toluene or benzene	55	8 h	>1000	1.8	[26]
26	n-butanol + water	R.T.	10 day	>1000	13	[27]
27	hexane	R.T.	4-5 h	2000	1.8	[28]
28	water	90	30 min	>1000	200	[29]
29	oleylamine	H_2O	4 days	~4000	1.6	[30]
30	toluene	R.T.	a few days	~1000	2	[31]
31	water	R.T.	>2 h	1000	50	[32]
32	tetrahydrofuran	R.T.	24 h	3000-6000	50	[33]
33	water	30	20 h	-	10	[34]
34	water	30	>12 h	>1000	30-80	[35]

[(a)] T = Temperature, [(b)] t = time, [(c)] l = length; [(d)] d = diameter; [(e)] R.T. = Room Temperature.

Table S2 Comparison of the ORR activity of the as-prepared Au nanowires with other Au-based catalysts reported before.

Number	Catalysts	E_{onset}/V	$E_{1/2}$/V	Electrolyte	Loadings (mg cm^{-2})	Ref.
1	**Au nanowires**	**1.06**	**0.881**	**0.1 M KOH**	**0.1019**	**this work**
2	AuPd NCs/rGO	0.92	0.86	0.1 M KOH	0.0849	[36]
3	PtAu SLAs	0.903	0.801	0.1 M KOH	0.0708	[37]
4	AuIr/C	-	0.774	0.1 M NaOH	0.2548	[38]
5	AuPt NDs	0.98	0.87	0.1 M KOH	0.0849	[39]
6	Au-Ni(OH)$_2$-NC/GCE	0.907	~0.65	0.1 M KOH	-	[40]
7	AuPd@PdAu-PEI	0.982	0.869	0.1 M NaOH	0.1019	[41]
8	AuPC-1	0.95	0.83	0.1 M KOH	0.0808	[42]
9	Au@TiO$_2$	0.92	~0.80	0.1 M NaOH	-	[43]
10	AuNDs-GO	~0.85	0.61	0.1 M KOH	0.04	[44]
11	Au-aerogel-CN$_x$	~0.92	~0.855	0.5 M KOH	0.13	[45]
12	AuCNS-30%	0.96	0.85	0.1 M KOH	0.0808	[46]
13	Au(51k-18k)/rGO	~0.714	-	0.1 M KOH	-	[47]
14	PO$_4$-CDs-6/Au	0.998	~0.80	0.1 M KOH	0.01414	[48]
15	Au/rGO	0.864	~0.764	0.1 M KOH	0.1	[49]
16	RGO/AuNPs	0.8413	-	0.1 M KOH	-	[50]
17	s-Graphene/PyPBI/Au$_{1.6}$	0.874	~0.664	0.1 M KOH	0.0053	[51]

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