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Supporting Materials

Robust self-stabilized electrode for high-efficient hydrogen evolution reaction based on Al-based metallic glasses

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Table S1. The overpotentials, Tafel slope and TOF of various HER electrodes in acidic electrolytes.

Catalyst	Onset overpotential η (V)	η (mV) at 10 mA/cm^2	Tafel slope (mV/decade)	TOFs (s^{-1})	Refs
$Al_{80}Ni_6Co_3M_3Y_5Au_3$	0.012	62	44	3.7 (η 200mv)	This work
MoS_2@RGO	–	100	41	–	[1]
Mo_2C@NPC/ NPRGO	–	34	33.6	–	[2]
WS_2/RGO	–	200	58	–	[3]
FeP/GS	0.03	123	50	–	[4]
MoS_2/MCNs	–	–	42	–	[5]
Mo_2C–CNT	–	152	55.2	–	[6]
Mo_2C/CNT–graphene	0.062	135	58	–	[7]
WO_2–CMNs	0.035	58	46	–	[8]
$Fe_{0.9}Co_{0.1}S_2$/CNT	0.09	120	46	–	[9]
CoP/CNT	0.04	122	54	–	[10]
CoP/MoS_2–CNTs	0	12	42	–	[11]
MoO_2@PC–RGO	0	64	41	–	[12]
NiMoNx/C	0.078	–	35.9	–	[13]
Fe–Co_2P/NCNTs	0.025	104	68	–	[14]
P–WN–rGO	0.046	85	54	–	[15]
FeCo@NCNTs–NH	0.07	–	72	–	[16]
CoNi@NC	0	142	104	–	[17]
SCEIN/SWNT	0	77	40	–	[18]
FeCo–C	0.088	262	74	–	[19]
Co@NC/NG	0.049	–	79.3	–	[20]
MoDCA–x	0.006	78	41	–	[21]
HMFeP@C	0.025	115	56	–	[22]
Fe_3C–GNRs	–	49	46	–	[23]
$CoSe_2$@DC	0.04	132	82	–	[24]
Cr–C	0.049	123	90	–	[25]
Ni–doped np–G	–	–	45	–	[26]
A–Ni–C	–	34	41	–	[27]
$CoSe_2$ NP/CP	–	137	40	–	[28]
CMSNA–8	0.121	–	43	–	[29]
Se–MoS_2/CC	0.06	127	63	–	[30]
Mo_2C/CC	0.03	140	124	–	[31]
CoP NPs/CC	0.033	48	70	–	[32]
Mo–W–P/CC	–	–	52	–	[33]
$Co(S_{0.73}Se_{0.27})$/CFP	–	–	45.3	–	[20]

MoS_2/CoS_2/CC	–	87	73.4	–	[20]
CoS_2/RGO–CNT	–	142	51	–	[20]
WO_3–x–CNFs	0.134	185	89	–	[34]
WS_2@P,N,O–graphene	–	125	52.7	–	[35]
NG–Mo	–	140	105	–	[36]
Co@NGF	0.014	124.6	93.9	–	[20]
MoS_2/graphene film	0.07	100	41	–	[37]
MoS_{2+x}/N–CNT/CP	0.135	160	36	–	[38]
MoS_2--CC	0.1	–	39	–	[39]
$WS_{2(1-x)}Se_{2x}$–CFs	–	–	105	–	[40]
$[Mo_3S_4]^{4+}$	0.15	250	120	0.07 (η 0mv)	[41]
$[Mo_2S_{13}]^{2-}$/Au	0.15	>300	58	0.47 (η 200mv)	[42]
$[Mo_2S_{12}]^{2-}$	0.1	161	39	3.27 (η 200mv)	[43]
$[Mo_3S_{13}]^{2-}$	0.11	200	39	3 (η 200mv)	[44]
Au NPs (10 nm)/C	0.11	>350	85	$4.43*10^{-4}$ (η 350mv)	[45]
Ni_2P	0.03	100	46	0.015 (η 100mv) 0.50 (η 200mv)	[46]
Np-Co_2P	0.024	80	44	0.0004 (η 0mv) 0.0045 (η 50mv) 0.05 (η 100mv)	[47]
MoP	–	–	–	0.019 (η 100mv)	[48]
Fe_2P	–	–	–	0.052 (η 100mv)	[48]
CoP	–	–	–	0.072 (η 100mv)	[48]
$Fe_{0.25}Co_{0.75}P$	–	–	–	0.095 (η 100mv)	[48]
$Fe_{0.5}Co_{0.5}P$	–	–	–	0.12 (η 100mv)	[48]
$Fe_{0.75}Co_{0.25}P$	–	–	–	0.045 (η 100mv)	[48]

Ni_2p	–	–	–	0.034 (η 100mv)	[48]
FeP	–	–	–	0.035 (η 100mv)	[48]
Co_2P	–	–	–	0.027 (η 100mv)	[48]
MoS_2/RGO	–	–	–	0.001 (η 100mv) 0.026 (η 150mv) 0.12 (η 200mv)	[49]
CoP	–	–	–	0.114 (η 100mv) 0.87 (η 150mv) 3.65 (η 200mv)	[49]
MoS_2 edge	–	–	–	1.25 (η 100mv) 7.42 (η 200mv)	[49]
MoP/S	–	–	–	0.089 (η 100mv) 0.505 (η 150mv)	[49]

Table S1. The yielding strength and electric conductivity for various materials used in HER electrodes.

Material	**Strength (MPa)**	**Ref.**	**Electric Conductivity (S/m)**	**Ref.**
Al-MG	220	–	2.6*E6	This work
Nafion112	12	–	10	[50]
20um 323k Nafion	16	–	7.5	[51]
20um 333k Nafion	20	–	9	[51]
Nafion 112 wet	19.1	–	7.5	[52]
Nafion 112 dry	26.6	–	9	[52]
32% porosity silica sol	10	–	1E-7	[53]
81% porosity silica sol	20	–	1.05E-4	[53]
PVDF/PAN1(90/10)	5	[54]	1E-4	[55]
PVDF/PAN1(90/10)	9	[54]	1E-4	[55]
PVDF	2.5	[54]	3E-7	[56]
PTFE/PA(15%)	40	[57]	5	[55]
5%CNT 95%PTFE	5	[57]	10	[58]
5%CNT 95%PTFE	20	[57]	10	[58]
CoS_2/RGO-CNT	32	[59]	3000	[59]
CoOx-CNT-CC	15	–	1250	[59]
CoOx-CC	5	–	400	[59]
M-CC	7	–	625	[59]
CC-700	11	–	588	[59]

CC	21	–	526	[59]
Nickel foam	3	–	100000	–
nanoporous Au	20	–	1000000	–
nanoporous Au	70	–	1.6E6	–

Figure S1. The optical image of ribbons for $Al_{97}Au_3$, $Al_{85}Ni_7Y_8$ and $Al_{80}Ni_6Co_3Mn_3Y_5Au_3$. The thickness of the electrode is 20 um, the width of the electrode is about 1.8 mm, the length of the electrode for electrochemical measurement is about 1cm.

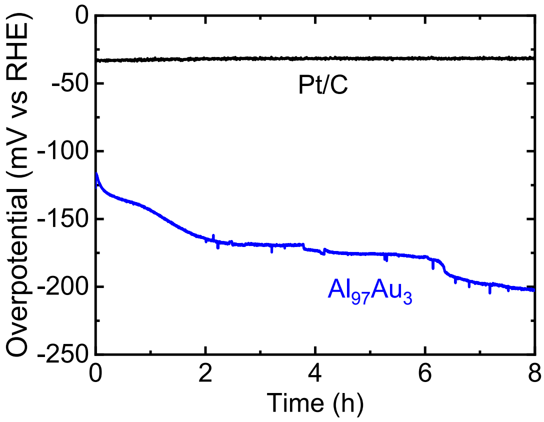

Figure S2. The reaction stability of $Al_{97}Au_3$ electrode in 0.5 M H_2SO_4 at a constant hydrogen evolution current of 10 mA cm^{-2}.

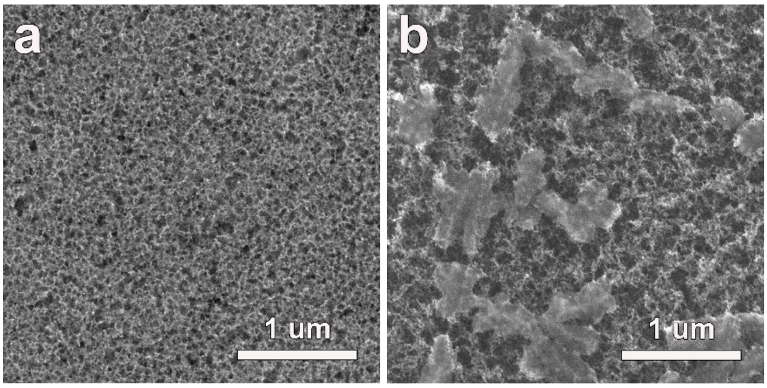

Figure S3. Comparison of the nanoporous microstructure (SEM images) for (a) the $Al_{80}Ni_6Co_3Mn_3Y_5Au_3$ electrode and (b) $Al_{87}Au_3$ electrode after 2 hours reaction in 0.5 M H_2SO_4 at 200 mV (versus 3.5 M Ag/AgCl). The ligaments coarsen and the nanopores get closed for the $Al_{87}Au_3$ electrode.

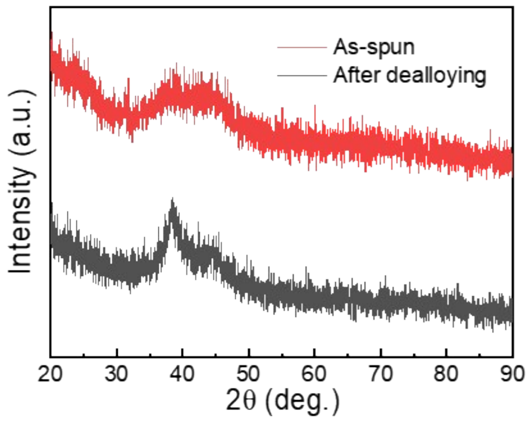

Figure S4. XRD patterns of as-spun and dealloyed $Al_{80}Ni_6Co_3Mn_3Y_5Au_3$.

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