Supporting Information

Investigation of the Commercial Aluminum Alloys as Anode Materials for Alkaline Aluminum-air Batteries

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Figure S1. The illustration of the hydrogen collection device.

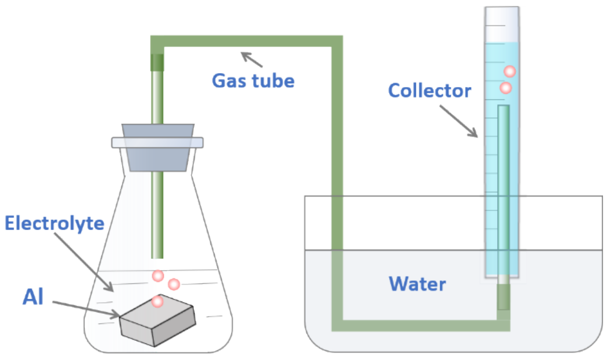


Figure S2. (a) The illustration of the flow-based Al-air battery, and (b) the corresponding digital image.

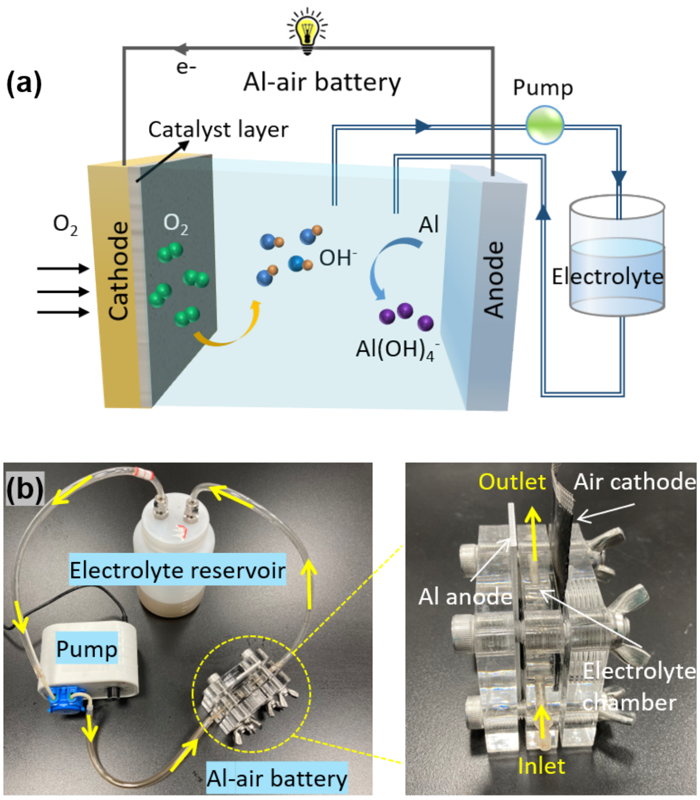


Figure S3. The self-corrosion measured by the weight loss method.

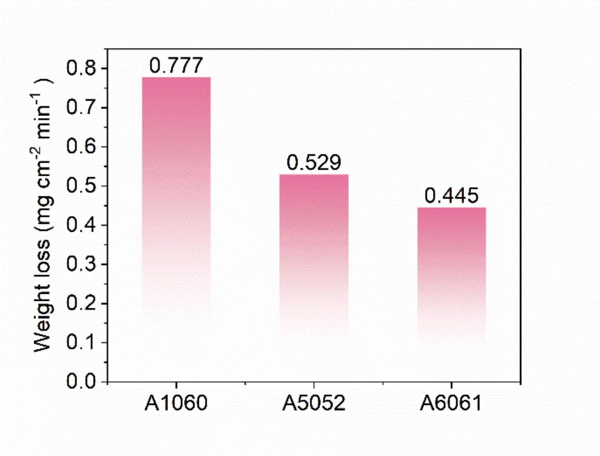
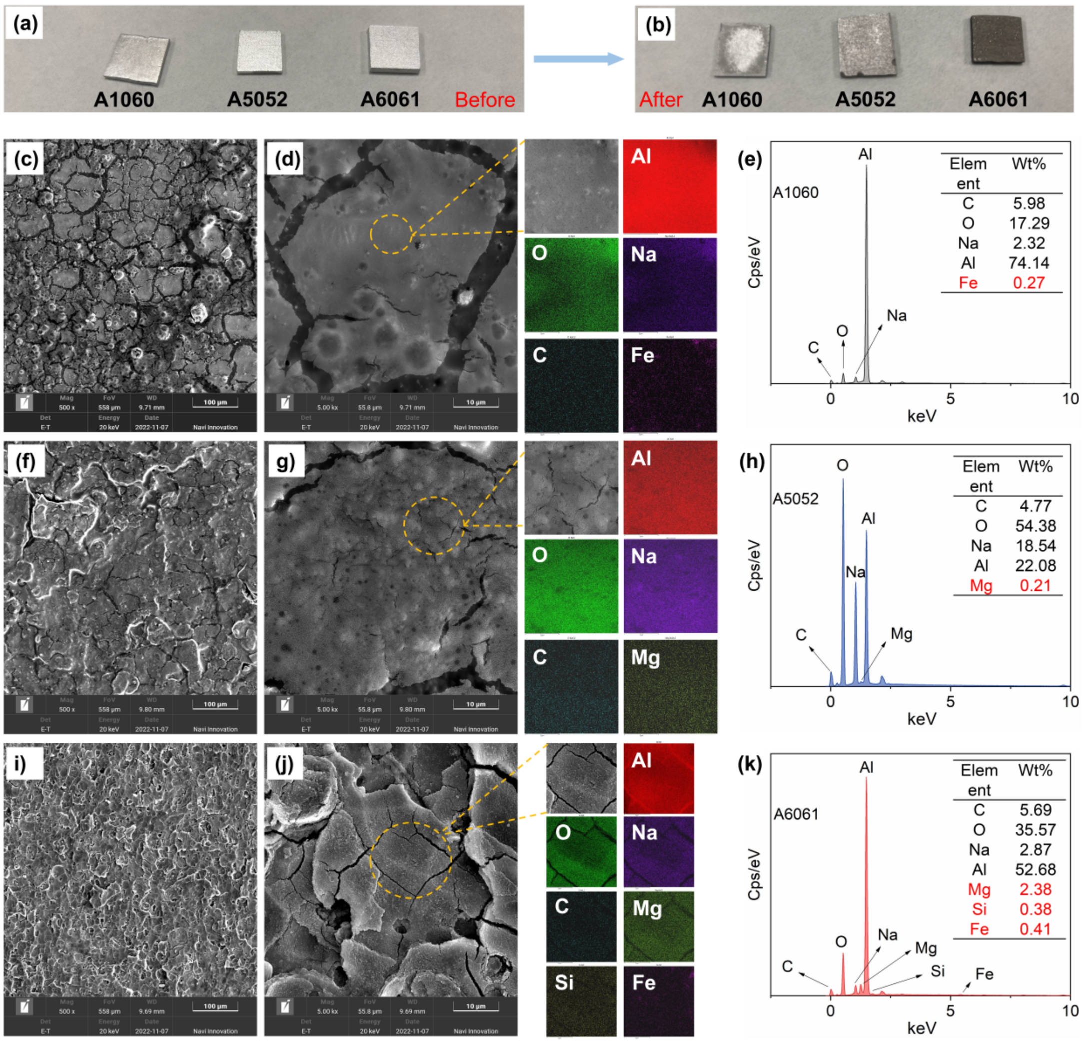


Figure S4. (a, b) The digital images of the Al alloys before and after testing in the alkaline solution. Morphology and composition characterization of the product films on the alloy surface after testing: (c-e) A1060, (f-h) A5052, (i-k) A6061.



It is obvious that the reaction products on the Al alloy surface are different. The products on 6061 Al alloy (A6061) are denser and more uniform (**Fig. S4 c, f,** and **i**). According to the element mapping results, the products are mainly composed of $Al(OH)_3$, Na_2CO_3, and NaOH residue. Na_2CO_3 is generated from the reaction between NaOH and CO_2 (from both the aqueous electrolyte (dissolved) and the air (during sample preparation)). However, the impurity elements and the contents are different. Because of the higher purity of A1060, Fe (0.24 wt.%) is the only impurity element on the A1060 surface (**Fig. S4 e**). Mg (0.21 wt.%) is the main impurity element on the

A5052 and A6061 surfaces (**Fig. S4 h** and **k**), as both are typical Mg-based alloys. Differently, there are additional Si (0.38 wt.%) and Fe (0.41 wt.%) elements on the A6061 surface. In alkaline solutions, Mg, Si, and Fe element would react to form precipitates to accumulate on the Al surface. Hence, the compositions of the product films are different.

Figure S5. The partial magnified discharge curve at 10 mA cm^{-2}.

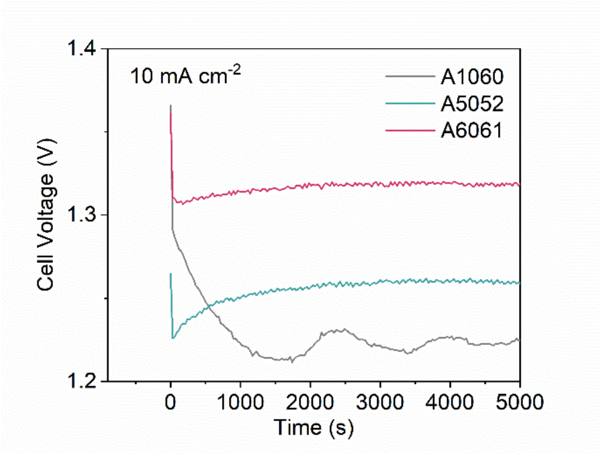


Figure S6. The formation mechanism of the deep corrosion hole.

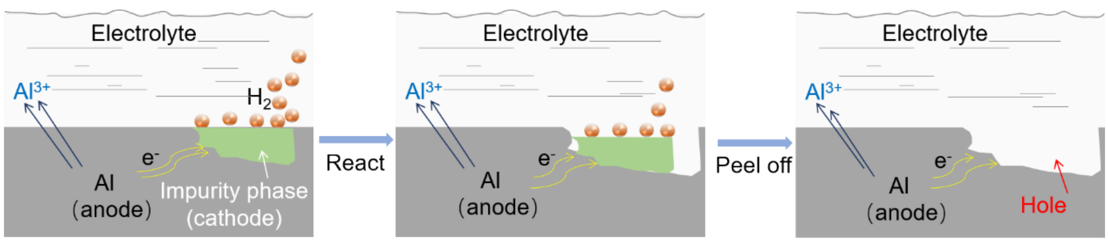


Table S1. The OCP, corrosion potential (E_{corr}), and corrosion current density (I_{corr}) of the alloy anodes.

Alloys	OCP (V)	E_{corr} (V)	I_{corr} (mA cm^{-2})
A1060	-1.261	-1.229	21.1
A5052	-1.292	-1.281	22.5
A6061	-1.417	-1.414	22.0

Table S2. The fitting values of the charge transfer resistance of the Al alloy anodes immersed in 4 M NaOH electrolyte.

Alloys	$R_{ct,1}$ (Ω • cm^{-2})	$R_{ct,2}$ (Ω • cm^{-2})
A1060	0.41	0.08
A5052	0.23	0.09
A6061	0.53	0.08

Table S3. The battery voltages, power densities, specific capacities, and energy densities of the A1060 anode at different current densities.

Current density (mA cm^{-2})	Voltage (V)	Power density (mW cm^{-2})	Specific capacity (mAh g^{-1})	Energy density (Wh kg^{-1})
5	1.3058	6.53	198.3	259.69
10	1.2236	12.27	348.93	429.14
20	1.1347	22.80	647.66	738.09
30	1.0476	31.80	990.93	1050.94
40	0.9704	41.24	1347.15	1389.48
50	0.8836	48.03	1658.17	1592.73
60	0.8225	49.32	1880.68	1547.25
80	0.6993	55.90	2419.55	1691.79

Table S4. The battery voltages, power densities, specific capacities, and energy densities of the A5052 anode at different current densities.

Current density (mA cm^{-2})	Voltage (V)	Power density (mW cm^{-2})	Specific capacity (mAh g^{-1})	Energy density (Wh kg^{-1})
5	1.2968	6.46	155.89	202.11
10	1.2568	12.55	345.67	434.43
20	1.1717	23.42	605.67	709.57
30	1.0971	32.89	925.48	1015.34
40	1.0391	41.55	1173.41	1219.21
50	0.9906	49.49	1320.08	1307.64
60	0.9091	54.38	1638.96	1489.79
80	0.7456	59.59	2145.96	1599.04

Table S5. The battery voltages, power densities, specific capacities, and energy densities of the A6061 anode at different current densities.

Current density (mA cm^{-2})	Voltage (V)	Power density (mW cm^{-2})	Specific capacity (mAh g^{-1})	Energy density (Wh kg^{-1})
5	1.3538	6.75	213.06	288.51
10	1.3139	13.15	402.98	529.37
20	1.2574	25.18	651.91	819.78
30	1.1908	35.80	930.72	1108.24
40	1.1378	45.50	1227.09	1396.13
50	1.0658	53.22	1491.54	1588.90
60	0.9658	57.91	2090.80	2020.00
80	0.7963	63.69	2660.69	2119.09

Table S6. The main elements and contents of the alloys (wt.%).

Alloys	Cr	Cu	Fe	Mg	Mn	Si	Zn	Al
A1060	0.0010	0.0046	0.20	0.0027	0.0094	0.060	0.012	Bal
A5052	0.17	0.0069	0.19	2.18	0.061	0.061	0.011	Bal
A6061	0.16	0.19	0.13	0.90	0.0053	0.34	0.008	Bal