

Performance and corrosion of aluminium-air battery in mixed electrolyte system

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Aluminium-air battery is a type of metal-air battery that utilizes aluminium as the anode, air as the cathode, and an electrolyte solution to facilitate the electrochemical reactions. It is regarded as one of promising battery for future because it offers several advantages including high theoretical energy densities, as well as environmental friendliness, abundance, and relatively inexpensiveness of aluminium metal [1,2]. Major challenges of aluminium-air battery, however, are limited rechargeability and corrosion of the aluminium anode upon its utilization. This research studies performance and corrosion of aluminium anode in aluminium-air battery with copper as a cathode and mixed electrolyte solution with different ratio of sodium hydroxide (NaOH) and sodium chloride NaCl). To elucidate the influence of air, the battery was operated with and without aeration at the cathode side. All the experiments were conducted under temperature of 30 °C. Performance of the constructed battery is tested using the battery-testing system (Landt, CT3002A Model), while corrosion of the aluminium anode is evaluated by measuring the weight loss of the anode upon its use. The Surface Morphology of aluminium anode before and after the use is characterized using scanning electron microscope (JEOL, JSM-6010LA Model). Monitoring the change of anode mass as well as analysis of the aluminium anode surface (Figure 1) indicates that although aluminium-air battery with NaOH electrolyte gave the highest power output due to the strong-base property of NaOH using NaOH-NaCl mixed electrolyte could significantly lead to much lower corrosion rate of aluminium anode in comparison with the battery that used only NaOH as its electrolyte. The aluminium-air battery using mixed electrolyte with NaOH:NaCl ratio of 1:19 was further tested for its performance under constant discharge current of 0.75, 1.5 and 3 mA. As shown in Table 1, discharge current clearly affected the battery performance and corrosion rate of the anode. The lowest anode corrosion of 0.64 mg·cm⁻²·h⁻¹ and highest energy density of 193.15 Wh·kg⁻¹ was achieved under the discharge current of 0.75 mA.

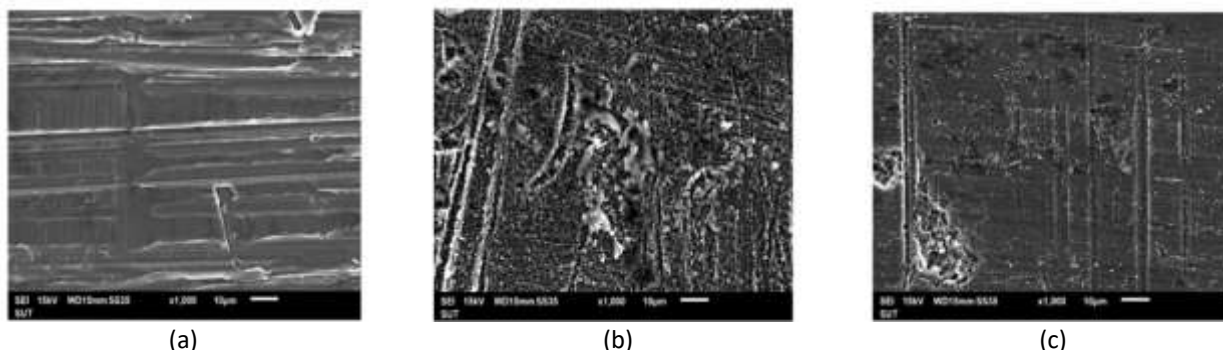


Figure 1. SEM image of aluminium (Al) electrode surface (a) new (unused) Al electrode (b) Al electrode of Al-air battery with mixed electrolyte with NaOH:NaCl ratio of 1:1 and (c) Al electrode of Al-air battery with mixed electrolyte with NaOH:NaCl ratio of 1:19

Table 1. Corrosion rate and performance of Al-air with mixed electrolyte with NaOH:NaCl ratio of 1:19 under different discharge current

Discharge current, mA	Corrosion rate, g·cm ⁻² ·h ⁻¹	Working time, h	Discharge capacity, mAh	Energy density, Wh·kg ⁻¹
0.75	0.64	5.50	4.13	193.15
1.5	0.83	6.00	9.00	104.03
3	1.28	3.23	9.69	23.85

References

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2. Q. Liu, Z. Pan, E. Wang, L. An, G. Sun, *Energy Storage Mater.* **27** (2020) 478-505 <https://doi.org/10.1016/j.ensm.2019.12.011>