Effects of Electrode Modification and Electrolyte Additive on the Air Electrode for Water Electrolysis

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Secondary rechargeable ZAFCs (zinc air fuel cells) with higher energy density than Li-ion batteries can be used for portable, mobile and stationary application [1,2]. During charge cycle, oxygen evolution reaction is taking place on the air electrode. Due to different requirement of the electrode on air side, two electrodes are used. One for oxygen reduction during discharge and the other one for oxygen evolution reaction during charge. This work is dealing with the electrode for oxygen evolution reaction (OER). Most researches are focus on developing of new catalyst to improve the cell performance[3,4]. This study is to investigate the effects of modification of electrode surface morphology and the addition of electrolyte additives on the performance of air electrode.

Stainless steel mesh was used as the substrate for this study. Three layers of coating at various coating currents was investigated. The results show higher coating current produced higher electrode surface area; low concentration of additives-1 was helpful to decrease over-potential. The best value of OER in 6.0M KOH solution is 0.87V.

The purpose of porous layer coating is to increase the surface area and to modify surface morphology of the electrode. Figure 1 is the over-potential of OER versus current density of sample that was coated at different currents. At a given current density, the over-potential of OER is lower for sample coated at higher coating current. Sample with higher surface area (higher i_{dl}) results lower over-potential. This is because of that sample coating at large current is more easily generates dendrite structure on the surface than sample coating at small current.

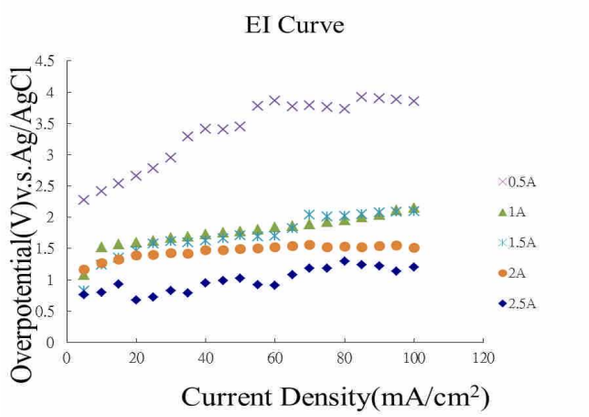

Fig. 1 Over-potential of OER in 6.0 M KOH solution at different current of porous layer

The effect of electrolyte additives on the OER polarization curve is given on Fig 2. Fig. 2 shows the over-potential is lower for electrolyte containing additive, especially containing 0.5% additive-1 that the over-potential is only 0.87V. Over-potential was reduced by adding the additive in all concentration range. Small bubbles were generated in electrolyte containing additives. Bubbles leave electrode surface much faster for small bubble than for large bubble.

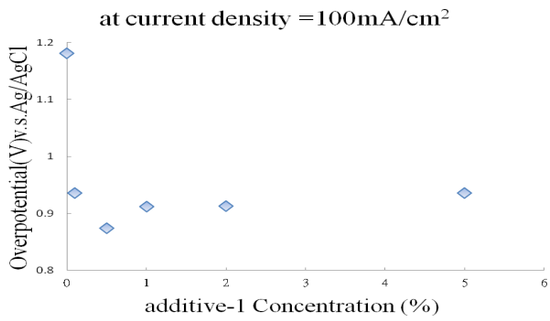

Fig.2 Over-potential of OER in 6.0 M KOH solution containing different concentration of additive-1

This work has demonstrated that the over-potential of OER is greatly reduced by increasing the electrode surface area and by introducing additives into the electrolyte. We can choose high current to modify electrode surface, and use additives -1 to reduce gas bubble size. The over-potential of OER was significantly reduced. The lowest value of OER in 6.0M KOH solution is 0.87V.

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