Carbon-free bifunctional cathodes for the use in Lithium - Air Batteries with an aqueous alkaline electrolyte

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Introduction

Metal-Air Batteries
- High theoretical specific energy density and capacity
- Oxygen is abundant, inexpensive and nontoxic
- High overpotentials during charging/discharging
- Low cyclability
- Low solubility of reaction products

This poster shows carbon-free silver based gas diffusion electrodes for the use as cathodes in metal-air batteries. The electrodes were electrochemically investigated with cyclic voltammetry and electrochemical impedance spectroscopy to identify the behaviour during oxygen reduction and evolution reaction as well as the loss mechanisms.

Materials and Methods

Cathode catalysts/materials
- Silver powder (Ferro AG)
- CoO2 powder (Sigma Aldrich)
- IrO2/ TiO2 powder (Umicore)
- PTFE powder (3M)

Cathode preparation
- Ag/CoO2 or Ag/IrO2/TiO2 powders and binder were mixed in a double knife mill
- Powders were filled in a forming frame covered with a stainless steel net and afterwards grouted to an electrode
- A heat treatment at 340°C for 1h enhances mechanical strength
- Thickness 330-397 µm

Experimental

• Cyclic Voltammetry was carried out in a half cell with 1 M LiOH, a potential range from 0.3 V to 1.8 V vs. RHE and at 25°C.
• Polarization curves were carried out at 0.3 V and 1.8 V vs. RHE for 15 min and 25°C.
• Long-term tests were also carried out at 25°C and 200 cycles.
• Potentiostatic EIS was carried out in the at OCV and at OCV ± 100 mV, ± 300 mV, ± 500 mV, ± 700 mV in the frequency range of 100 mHz to 100 kHz.

Conclusions

• Carbon-free silver-based gas diffusion electrodes were developed
• GDE’s with 20 wt. % CoO2 or IrO2 exhibit the highest current densities and stable current densities in potentiostatic mode
• Ag/CoO2-electrodes show an excellent long-term stability (< 200 cycles)
• Resistances calculated from impedance spectra correlate to achieved current densities

References


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