More Specific Energy in Rechargeable Zn/Air Cells

Franziska Holzer and Stefan Müller

Paul Scherrer Institut, Laboratory for Electrochemistry, CH-5232 Villigen-PSI, Switzerland

Introduction

Electrically rechargeable energy storage concepts leading to high specific energy, low cost and environmentally compatible components are urgently needed for power sources in electric vehicles, stand-alone photovoltaic applications or portable electronic equipment. Due to its high theoretical (1150 Wh/kg) as well as practical specific energy (60-150 Wh/kg) and also due to the low cost and low toxicity of the materials involved, the secondary Zn/air battery is a very attractive candidate for energy storage concepts.

A large part of recent work has concentrated on the cycle life of components of rechargeable Zn/air cells. Significant progress has been made concerning the cyclability of the system by utilizing pasted zinc electrodes with improved cellulose additives, low zinc solubility in alkaline electrolytes, and metal oxide catalysts dispersed on graphitized carbon for the bifunctional oxygen diffusion electrodes [1], [2].

General aspects with respect to specific energy and specific power of the battery system will be discussed. The focus will be on cycle life of the battery including the cycle/service life of the bifunctional O_2 electrodes. Also the need for CO_2 filters in systems operated with ambient air [3] as well as the type and amount of separator material to be used will be discussed. It will be shown that the system's specific energy will benefit from an increase in capacity of the zinc electrode. Also, the relation between specific power and specific energy will be examined.

Experimental and Results

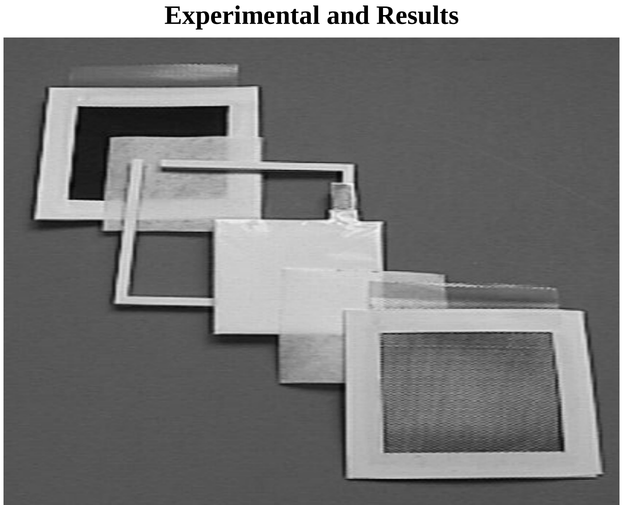

Fig. 1: Cell arrangement of the 50 cm^2 secondary Zn/air battery. The Zn anode is placed between two bifunctional O_2 electrodes.

Both electrodes of the electrically rechargeable Zn/air battery are prepared at our laboratory. The anode is made by a pasting method [1], the cathode by a calender-rolling technique [4]. The electrodes were tested using a sandwich cell arrangement of the components such as that depicted in Figure 1. The electrolyte was a KOH solution presaturated with ZnO.

The capacity of the cell was raised by a factor of 1.5, by increasing the thickness of the zinc electrode by the same factor but retaining its size. There was no loss in coulombic efficiency, hence the cell's specific energy also increased. Figure 2 shows the discharge performance of two cells, a 5 Ah cell (previous electrode thickness) and a 7.5 Ah cell (new electrode thickness).

The power drain capability of the system was the same for the two cells, but due to the larger mass of the 7.5 Ah cell, its resulting specific power is lower.

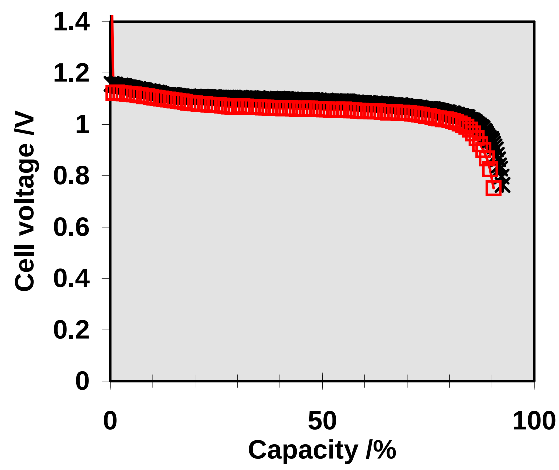

Fig. 2: Discharge performance of 50 cm^2 secondary Zn/O_2 cells with capacities of 5 Ah (□) or 7.5 Ah (✶).

Acknowledgments

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