

PRINTED AIR-ELECTRODES FOR THIN-FORM BATTERIES

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The need for high-power, thin-form batteries is becoming increasingly recognized especially for portable applications. More devices require high power batteries tailored to meet their shape, size, operating requirements and flexibility. This requires breakthroughs in materials performance and in advanced thin form fabrication through chemistry and printability. It is well recognized that performance of energy devices can be greatly enhanced by improved materials and thinner controlled-composition layer structures. However, the conventional methods of preparing electrodes are limited by the thickness and control of the interface of the electrode layers. Control over the transport of active species between the interfaces of the layers is crucial to the performance of an energy device. Printing allows for this controlled microstructure and composition of the layers.

This paper discusses the printing of the active layer to prepare an air-electrode used in metal-air batteries. Active layers were syringe dispensed or screen printed on the gas diffusion layer. The thickness of the active layer can be controlled by the solid loadings of 5 to 20 mg/cm² and by the speed of the deposition. Inks were formulated with the electrocatalyst and other components to control the transport processes through the layer.

In the case of an air electrode under alkaline conditions (7N KOH), the polarization curves for the different layers using the same materials were obtained as seen in Figure 1. The active layer loading of 20 mg/cm² was deposited by conventional methods, i.e., by pressing a catalyst layer on the gas diffusion layer. The active layer of 5 mg/cm² was deposited on the gas diffusion layer by syringe dispensing.

The printed mass loading of 5 mg/cm² in oxygen has lower performance compared to the 20 mg/cm² layer deposited conventionally. This might be expected based on the lower mass of active material present. However, in air, the 5mg/cm² printed layer has only slightly lower performance compared to a conventionally deposited layer with 4 times more material. This is due to the improved transport characteristics of the printed layer structure.

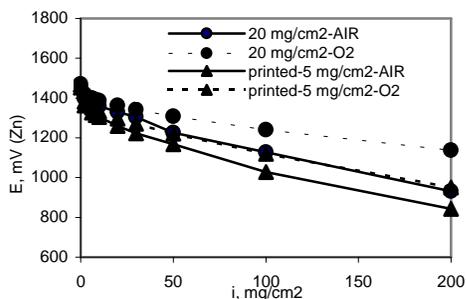


Figure 1: Polarization curves for alkaline air-electrodes comparing active layers deposited by conventional method and by printing.

The difference between the electrochemical performance in oxygen vs. air reveals information on the diffusion characteristics of the layer. The plot in Figure 2 illustrates this difference and shows the improved layer characteristics of the printed layer.

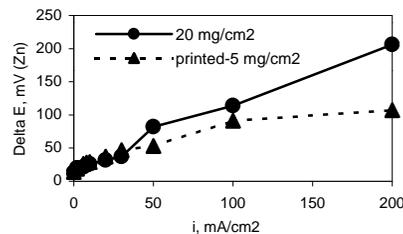


Figure 2: Plots of the difference in potential as a function of current density based on the polarization curves illustrated in Figure 1.

An example of a printed air electrode in cross section is shown in Figure 3. Evaluation of a range of loadings of the active layer is currently under investigation and will be presented.

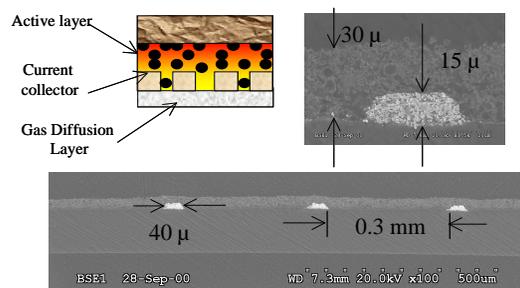


Figure 3: Cross sections of a printed air-electrode comprised of a gas diffusion layer, printed current collector and printed active layer.