



Gas Diffusion Electrodes

- **Air Cathode Development**
- **Cathodes for Alkaline Metal-Air Systems**
- **Cathodes for Saline Systems**
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ALUPOWER'S AIR CATHODES

The Alupower Air Cathode Development

Alupower has developed a unique system for the manufacture of gas diffusion electrodes for metal-air or fuel cells. This development provides the lowest cost air cathodes for Alupower's growing line of aluminum-air batteries.

The Alupower air cathodes are made by heat-lamination of several different layers to form a single multi-ply cathode. This is done on a continuous-web basis, providing manufacturing economy. With these new cathodes, aluminum-air batteries have become cost-competitive in major new markets.

Air cathodes made by this process are available to meet specific customer applications. Cathodes can be made up to 11 inches wide, and in any convenient length.

Alupower Cathode for Alkaline Metal-Air Systems

Alupower's primary development effort has been on cathodes for alkaline systems. The AC65 air cathode is a four-layer product designed for standby power units and power cells for vehicle propulsion. The graph of Polarization voltage vs. Current density is shown in Figure 1.

POLARIZATION VOLTAGE OF ALUPOWER AC65 Cathode

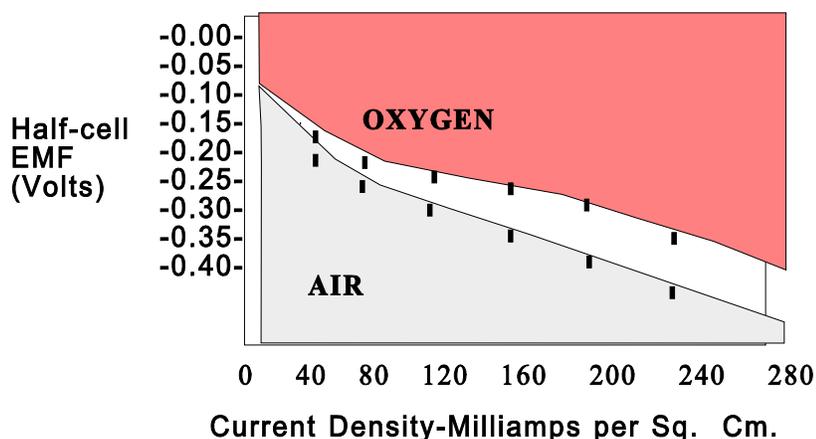


Figure 1. Polarization data of Alupower AC65 air cathode. 5M KOH electrolyte. Hg/HgO reference electrode. 60°C.

The AC65 is used in alkaline aluminum air cells with current densities of up to 150 mA/cm². A typical cell voltage is 1.28 V at current density of 100 mA/cm² in KOH electrolyte.

Alupower Cathodes for Saline Systems

For saline electrolyte and seawater, the AC51 air cathode is preferred. This cathode was developed for 1000 hours life at current density of approximately 10 mA/cm². The AC51 has also given good results in zinc-air and magnesium-air applications. The Polarization voltage and Current density data is shown in Figure 2.

POLARIZATION VOLTAGE OF ALUPOWER AC-51 Cathode

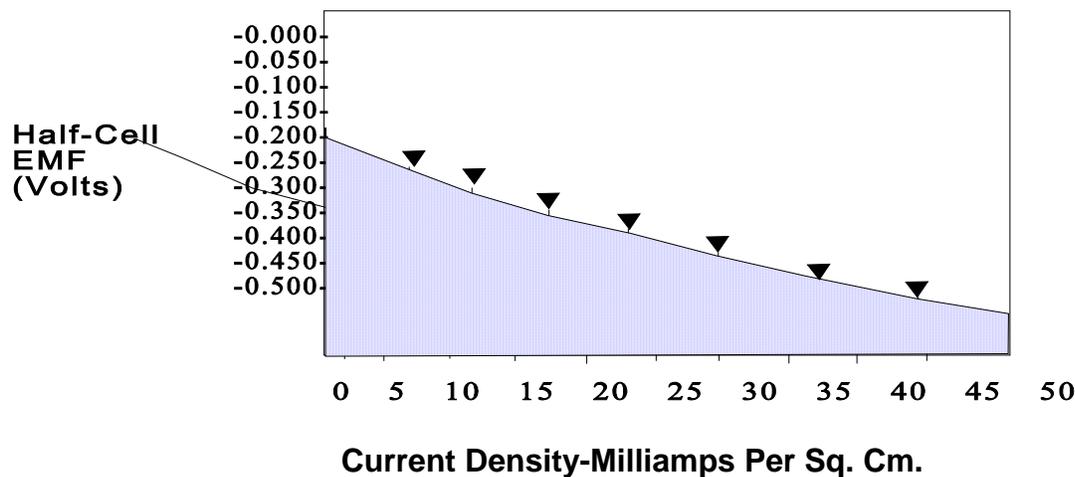


Figure 2. Polarization data of Alupower AC51 air cathode. 12% NaCl electrolyte. Standard calomel reference electrode. Room temperature.

If used in an aluminum-air cell with 12% NaCl electrolyte, using Alupower (aluminum alloy) AB50V, a cell generates 1.07 volts at a current density of 30mA/cm².

General Design of Alupower Gas Diffusion Electrodes

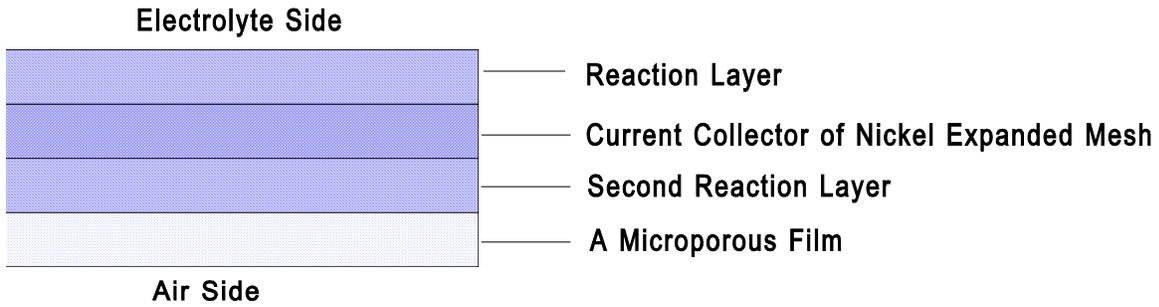
The AC65 Cathode has four separate plies. There are two reactive “carbon” layers, a current collector, and a microporous hydrophobic film. The current collector is placed between the two carbon layers, and the hydrophobic film is on the outside surface which becomes the “air side” as shown in Figure 3.

The reactive carbon layer consists of carbon-fiber nonwoven which has been impregnated with a mixture of carbon black and other additives. These two plies of electrically conductive reinforcing fibers provide a low cost electrode that meets extreme environmental demands while maintaining it's excellent performance.

The multi-layered cathode design makes it possible to modify the cathode to achieve special performance. This can be done by modifying one or more of the individual layers.

Other Multi-Layered Electrodes

The Alupower system for fabricating laminated air cathodes has been used to make other battery components, supercapacitors, and electrodes for electrosynthesis applications. Gas diffusion electrodes for hydrogen-oxygen fuel cells, and rechargeable air cathodes are examples of products which can be made by this process. These modifications can be made by changing one or more of the individual cathode layers.



**Figure 3. Cross Section of Alupower AC65 Air Cathode
(Total thickness about 0.020 inch)**

Other cathodes include the AC71 catalyzed with a Cobalt catalyst that will provide an 80 millivolt improvement over the AC65 cathode.

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