Lightweight Nickel Electrode Development Program

Nickel-hydrogen boilerplate cell.

Because of its relatively high specific energy and excellent cycling capability, the nickel-hydrogen ($Ni-H_2$) cell is used extensively to store energy in aerospace systems. For the past several years, the NASA Lewis Research Center has been developing the $Ni-H_2$ cell to improve its components, design, and operating characteristics. The battery size and weight are crucial parameters in aerospace and spacecraft power systems for applications such as the International Space Station, space satellites, and space telescopes. The nickel electrode has been identified as the heaviest and most critical component of the $Ni-H_2$ cell. Consequently, Lewis began and is leading a program to reduce the electrode's weight by using lightweight plaques.

Using a lightweight nickel plaque in place of a heavy sintered nickel plaque is expected to improve the specific energy, weight, and performance of the nickel electrode. The three nickel fiber plaques used in this development program were developed by Memtec America Corporation, Ribbon Technology Corporation, and Auburn University. These new materials enable plaques to be made with reduced pore sizes as well as with increased surface area, conductivity, strength, and porosity. The plaques are fabricated into nickel electrodes by electrochemically impregnating them with nickel hydroxide active material.

A boilerplate $Ni-H_2$ cell with a lightweight nickel electrode was fabricated and is currently being tested in-house at Lewis at a 60-percent depth of discharge. So far, the cell has accumulated over 1000 cycles with stable voltage.

In this combined effort, Lewis has a contract with Hughes Space and Communications Company to transfer the technology and is working with Eagle Picher Industries to commercially develop the lightweight nickel electrode. Lewis also has a grant with the Space Power Institute (Auburn University) to develop a high-performance nickel-hydroxide electrode with composite microstructure nickel-fiber electrodes. These electrodes are being tested in boilerplate Ni-H_2 cells both at Hughes and Lewis.

Improving the lightweight Ni-H_2 cell will benefit NASA (exploratory platforms and rovers) as well as commercial aerospace companies (communication satellites). It will also benefit commercial battery companies that use nickel-based electrodes (e.g., nickel-metal-hydride and nickel-cadmium systems).

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