Planar Sodium Metal Halide Battery for Renewable Integration and Grid Applications

John P. Lemmon, Xiaochuan Lu, Guosheng Li, Vincent Sprenkle, Brent Kirby, Nathan Canfield, Jeff Bonnett, Richard Pearson, Eric Mast, Gary Yang, and Kerry Meinhardt.

Energy Materials Laboratory
Pacific Northwest National Laboratory
902 Battelle Blvd Richland WA 99352

Abstract
Environmental and security concerns over the continuous increase of fossils fuels used for large scale electrical energy generation has led to an increase in renewable sources on the grid. Although advances in renewable technology such as wind and solar are still needed to be economically competitive in most markets, global capacity has grown quickly and is expected to continue rapid growth for several years. As these sources are further implemented their variable nature creates significant challenges for electric grid operators to maintain stability and supply with existing grid technology. To compensate for the intermittency of large scale renewable energy production, low cost electrical energy storage technologies that are modular and scalable (kW-MW) will become necessary.

A leading candidate for these applications is sodium beta batteries (NBB) that incorporate a solid Na^+ conducting beta-alumina (β''-Al_2O_3) electrolyte (BASE). More specifically, is the ZEBRA NBB that is based on reversible metal halide couple and incorporates a molten salt in the cathode chamber. These batteries have demonstrated round-trip efficiencies >90%, storage capacity up to KWhs for hours of duration, and millisecond response times. However, current ZEBRA is constructed with 1-2 millimeter thick, tubular, electrolytes and require high operation temperatures (>300°C) that impact materials cost and cycle life. Recently, we have focused on developing a planar ZEBRA type cell using a thin flat plate BASE. The planar design offers several performance and manufacturing advantages over current tubular cells. Potential performance gains include adjustable power to energy ratio, reduction of specific resistance leading to decreased operating temperature, and increased power and energy in full packs due the increased packing density. Manufacturing cost can be reduced by using lower cost materials, integrated module design, and high yield production process for the flat plate BASE.

In this presentation, recent results generated from 3 and 64cm^2 button cells, including base line cell performance, cell design and chemistry will be presented. Potential degradation modes from cell teardown and analysis along with initial data on three cell stacks will also be shown.

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