BATTERY TESTING: CHARACTERIZATION OF THINGS AS THEY ARE

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The problem of obtaining meaningful measurements of physical and chemical characteristics of electrochemical systems such as batteries, fuel cells, and sensors has become critical during the past few years as the field of electrochemistry has developed and matured. For example, there exists at the present time a multitude of methods and techniques which have the potential for developing characterization information, but many of these methods depend upon physical principles originally discovered and investigated without regard to possible application to electrochemical devices. These techniques often require specialized esoteric equipment and have remained the concern of small groups of scientists who each usually serve an important function in supplying diagnostic information. Many of the disciplines have become highly developed and self-sufficient with their own competences, their own vocabulary, their own symposia and their own societies. Each group explores the potentials of its own areas in depth, but interest in cross-fertilization with other parallel competences is often minimal.

One purpose of this workshop is to obtain a glimpse of alternative models for testing, and proper perspective for technology characterization. The end user of such information does not care whether the effort has come from chemistry, physics, spectroscopy, electrochemistry, or nuclear techniques. Rather, one wants accurate and properly correlated information. In the past decade the studies of battery characterization and post-test analysis have developed rapidly, and this has greatly expanded requirements for appropriate information which ultimately led to the establishment of the Battery Energy Storage Test (BEST) facility, and the National Battery Testing Laboratory (NBTL) and their many methods of characterizations.

We might ask the question, "Why are tests made?" The crude tests of the earlier days were for the exploration of an unknown technology, for the characterization of electrical performance, and for the charting of materials and compounds found in battery components. Next came the analysis of the structure of the components and the determination of macroscopic and microscopic characteristics.

Yet, because of a constant drifting toward specialities, some testing engineers limited testing to dealing with one or two variables instead of the many often involved. To accelerate advancement, with new developing technology we must capitalize on all techniques, especially those involving important tests incorporating *in situ* characterization and kinetic measurements.

There are four questions that this workshop should try to answer:

(i) What test and characterization should be made?

(ii) What methods should be used?

(iii) What accuracy is required?

(iv) What testing cost is allowable?

Now let me turn to DOE's Battery Evaluation Program. The Battery Evaluation activities encompass the Battery Performance and Evaluation and the Engineering Analysis Elements, which are divided into three tasks:

(i) Advanced batteries are being evaluated, using specialized test regimes in laboratories in Sandia and under contract at industrial laboratories. Technologies tested include sealed lead-acid, zinc/chlorine, zinc/bromine, Redox, zinc/ferricyanide, and nickel/hydrogen and sodium/sulfur.

(ii) Sandia personnel are also performing battery system field test experiments in remote sites and in-system test facilities.

(iii) The National Battery Test Laboratory (NBTL) at Argonne National Laboratory is conducting the necessary battery verification and performance characterization tests on improved batteries for electric vehicle and load-leveling application-specific regimes. Progress in each task will be described at this meeting.