The cycling studies of sulfolane electrolytes in Li half-cells will be continued to assess their cycling efficiencies and to gain insight into purification. The cycling will be extended to sulfolane–ether mixtures showing greater conductivity and lower viscosity than sulfolane alone. If acceptable cycling is observed in half-cells, Li/TiS_2 cells will be constructed and cycled.

OVERVIEW OF IRON/AIR BATTERY DEVELOPMENT AT WESTINGHOUSE

Westinghouse Electric Corporation, Research and Development Center, Pittsburgh, PA 15235 (U.S.A.)

The development of the iron/air system at Westinghouse has concentrated on the bifunctional electrode during the last 2 years. The current program goals are to demonstrate stable performance compatible with a commuter electric vehicle mission with cycle life in excess of 1000 duty cycles. Work in previous years has demonstrated stable performance for the iron electrode at 0.4 A h/g. This level of performance is compatible with the vehicle requirements for this battery system. Additional work to advance this level of performance was deferred to concentrate our efforts on the air electrode.

The research and development program on the air electrode has three basic tasks with a parallel program at Case Western Reserve University (CWRU) complimenting these areas of research. The first task is to advance the performance and life of the current state-of-the-art bifunctional air electrode.

The current electrode system has demonstrated stable performance for greater than 500 cycles over 4000 h of testing. Alternative electrode compositions and electrode processing procedures were evaluated and tested. The results have indicated that the structure of the current air electrode overrides the catalyst used for performance and life. The results of CWRU have substantiated the chemical stability of the state-of-the-art air electrode while also identifying structural deficiencies in the current electrode system. Recent test results of various state-of-the-art electrodes will be discussed.

The second area of research has considered alternative electrode compositional additives for improved performance in the oxygen evolution mode as well as the oxygen reduction mode. Initial characterization of the candidate additives used cyclic voltammetry in conjunction with a floating electrode technique to determine perhydroxyl rate elimination constants. As a result of the screening of possible additives, a new combination of materials has been identified. To date, these new additives have demonstrated nearly equivalent performance to the state-of-the-art electrode for 500 cycles. These procedures and test results will be discussed.

The third area of study was involved with failure analysis of air electrodes. A series of eight air electrodes were life tested at Westinghouse. At various cycles, these electrodes were delivered to CWRU for analysis. The results of this analysis in general indicated that the silver catalyst was not lost during cycling for over 400 cycles. The details of this testing and analysis will be presented and discussed.

The program is currently oriented toward advancing the performance and life of the bifunctional air electrode. Studies have recently been initiated to investigate the nature of various carbons for use in the system. The results of some tests in this area will be presented and discussed.

The contract will be completed on December 31, 1982.

BIFUNCTIONAL OXYGEN ELECTRODES

Case Center for Electrochemical Sciences, Case Western Reserve University (CWRU), Cleveland, OH 44106 (U.S.A.)

The purpose of this research is to significantly improve the efficiency and life of the bifunctional oxygen electrode for use in rechargeable iron/air cells. This is being accomplished by developing the following:

- O_2 reduction and generation catalysts that combine good activity and stability,
- A more oxidation-resistant carbon, and
- An improved electrode structure.

Until recently, a significant amount of effort has been expended toward understanding the catalytic system and failure mechanisms of the Westinghouse bifunctional air electrode. As a fair degree of understanding has been achieved and has already led to improvements in the catalytic system, the emphasis has shifted to new catalysts, supports, and electrode structures.

Understanding the life history of Westinghouse bifunctional air electrodes

In an attempt to understand the changes in the physical and chemical aspects of Westinghouse electrodes responsible for electrode break-in and failure, 10 identical electrodes were cycled at Westinghouse for various lengths of time. They were then examined at CWRU using X-ray energy-