ELECTROCHEMICAL PROPERTY ANALYSIS OF ZINC-BROMINE ELECTROLYTE

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Abstract - A zinc bromine flow battery (ZBB) provides the advantages of giving long cycle life, low cost of maintenance, flexible design and high efficiency for energy storage system [1, 2]. Electrolyte of the ZBB is primarily composed of an aqueous zinc-bromide salt dissolved in water and is stored in external two tanks. During charging, the zinc bromide salt is split into zinc metal and elemental bromine. On discharging, the metallic zinc plated on the negative electrodes dissolves in the electrolyte and is available to be plated again at the next charge cycle. The ZBB is an attractive and useful technology for large-scale energy storage due to its higher energy density, but during cell charging and discharging its distinctive-electrochemical (electrolyte) property causes a lot of problems such as zinc growth on the anode, water transfer to a zinc half-cell, bromine aggregation by a complex agent, bromine absolution on a separator surface, reaction rate unbalance due to metallic and liquid phase transitions and etc. This paper describes such zinc-bromide electrolyte problems due to cyclic operation of a ZBB cell and analyzes their potentially fatal effects on long-term performance and durability of the ZBB cell. For this purpose, experiments of ZBB cell and cyclic voltammetry are carried out, and the scanning electron microscopy (SEM) is used to observe the morphology of the membrane surface after the cyclic operations. Especially, during cyclic charging and discharging operation, the real-time variations (of temperatures, pHs and water-transfer rate) in the anolyte and catholyte are measured as functions of time, and its effects on the performance and stability of electrolyte in the ZBB cell are also analyzed. This study provides a new insight into the development of ZBBs for high-performance, stability and durability for long-term operation.

Index Terms - Zinc bromine flow battery(ZBB), Zinc-bromide, Electrolyte, Cyclic operation, Stability, Long-term operation