

CHARACTERIZATION OF BATTERIES

Brief Introduction

NiCd batteries are still widely used as portable energy sources, though alternatives such as NiMH and Li-ion batteries have supplanted them for many applications. Your job is to use standard methods to characterize the performance of a commercial NiCd battery during discharge and recharge. It is up to you to read the literature provided (and any other literature you think might be helpful) and decide what characteristics of a rechargeable battery are important and what you can accomplish in 3 weeks. In addition to characterizing the charge and discharge behavior of the battery, you are also asked to analyze the free energy, enthalpy, and entropy of reaction for a recharged NiCd battery.

Related Background Reading

"Electrode kinetics for chemists, chemical engineers, and materials scientists," E. Gileadi, pp. 455-476, VCH Publishers, Inc, New York (1993).

Experiment

You have access to a PAR 173 potentiostat, computer, and a few of batteries (250 mA-h capacity) that have been fully recharged or fully discharged prior to your use. Using these facilities, you should perform a series of battery characterization experiments with one of the batteries given to you. The literature you've been provided with can help you decide which properties of the battery are important to determine. SAFETY WARNING: Use caution when recharging the battery (especially if you are using constant current recharging), because over charging the battery will cause gas evolution within the sealed cell, and may result in an explosion of the battery---monitor cell potential carefully to avoid this! Using the second battery, one of the group members should analyze the free energy, enthalpy, and entropy of reaction for the NiCd battery. Your report should discuss these results and compare them with similar results published in the literature. Do your results have any implications for the best way to charge or discharge a NiCd? Based on your results and those in the literature, indicate why NiCd is being replaced supplanted by metal hydride and Li-ion batteries.