

Detection of Off Gassing from Li-ion Batteries

Arun Agarwal, Davion Hill, Ben Gully, Michael Kleinberg, Brandon Zander, Ali Nourai
Det Norske Veritas (U.S.A.), Inc.
 5777 Frantz Road, Dublin OH 43017

Lora Thrun, Scott Swartz, Mark Koslowski, Steve Cummings
NexTech Materials
 404 Enterprise Dr, Lewis Center, OH 43035

John Butkowski, Brad Moore
Beckett Energy Systems
 38251 Center Ridge Rd., North Ridgeville, OH 44039

Abstract

Emission of flammable gases, especially organics as off gas from Li-ion batteries presents a significant safety risk due to its unpredictable release. Recent safety incidents involving Li-based battery chemistries have occurred across automotive, marine, electric grid, and aviation sectors and indicate a need to understand battery failure and the implications for control of the thermal event and the off gas hazard. The work presented summarizes the early results of an ARPA-e AMPED funded study (2012-2015) to qualify a novel sensor for off gas detection. Preliminary results indicate the sensor can detect off gas prior to thermal events. The remainder of the program will address whether the sensor can detect off gas prior to significant failure events and whether battery functionality can be preserved after abuse events. In addition, with enough prior warning from the sensor there is a desire to determine whether it provides suitable control at the fringes of battery performance and also acts as a state of health sensor. The implications for off gas monitoring will be investigated in several contexts including life extension, second life batteries, and the use of batteries in new environments with varying safety considerations. In this work, we shall present results on detection of off gas from batteries as they are subjected to thermal abuse, charge/ discharge cycling, with variations to encompass the most to least aggressive conditions for operation. Off gas samples shall be analyzed via GC/MS to tune and calibrate the response of sensors placed in the vicinity of the operating battery.



Figure 1 Testing boxes for atmospheric and temperature control of battery cells.

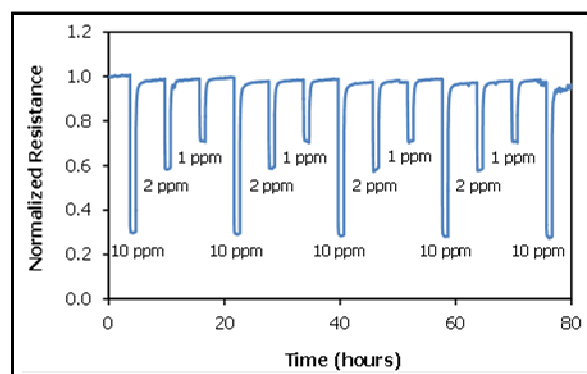


Figure 2 Response of off gas sensor to ppm levels of Diethyl carbonate, a common electrolyte in Li-ion cells.

References:

1. George Andrews, et. al, Oakridge national lab, "Economic Analysis of Deploying Used Batteries in Power Systems", ORNL/TM-2011/151, June 2011
2. General Motors Press Release, November 14, 2012. "GM, ABB, Demonstrate Chevrolet Volt Battery Reuse Unit." http://media.gm.com/media/us/en/gm/news.detail.html/content/Pages/news/us/en/2012/Nov/electrification/1114_reuse.html
3. Thompson, Shane. "Project Status Report". Kinsbursky Brothers, Inc. 2012 EWI Battery Symposium. May 3, 2012.
4. Miller, Ted. "Battery Reliability and Safety". Ford Motor Company. May 3, 2012. 2012 EWI Battery Symposium, Columbus, OH.
5. "Risk Based Evaluation of Batteries for Transportation and Energy Storage Applications" Rev. 2 OCTOBER 2012 DNV Research and Innovation Report Number: 2012-9804