

Effect of Water and Oxygen on the Thermal Stability of LiPF_6 EC:EMC Electrolyte for Lithium Ion Batteries

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Introduction

Despite the improvements in safety of the lithium ion batteries, there are still some safety concerns associated with these batteries, especially for their scale-up to large applications.¹ In order to improve the thermal stability of these batteries it is necessary to perform thermal stability studies of the components of the battery to have a better understanding of the problem. Botte *et al.* has studied the thermal stability of LiPF_6 EC:EMC but the effect of water and oxygen on the electrolyte was not analyzed.

The objective of this work is to study the influence of impurities such as water and oxygen on the thermal stability of the electrolyte mixture LiPF_6 EC:EMC. A Differential Scanning Calorimeter (DSC) along with first principle calculations would be used to fulfill the objective.

Experiment

A Differential Scanning calorimeter was used during the experiments. A detail description of the experiments is given in Botte *et al.* The electrolytes were obtained from EM industries Inc. Some of the DSC samples were prepared in a dry room at a temperature between 22 and 24 °C and a dew point of -60 °C. Other samples were prepared in argon filled glove box with less than 20 ppm of O_2 . The samples were hermetically sealed. Stainless Steel DSC pans from Haake were used during the experiment. The weight of the samples was taken before and after the experiment to verify that the system was hermetic. In all the cases the weight was constant indicating that there were no leaks during the experiment. The measurements were carried out in a DSC 2910 from Thermal Analysis Instruments.

Results

Figure 1 shows the effect of the presence of water and oxygen on the thermal stability of the salt. The results indicate that the presence of O_2 does not affect the thermal stability of the salt at temperatures lower than 350 °C. On the other hand, the presence of water increases the thermal reactivity of the salt. A large non-reversible exothermic peak was caused by the presence of excess of water in the sample. Further results would be presented.

References

1. G. G. Botte, R. E. White, and Z. Zhang, Accepted for publication in Journal of Power Sources (January 2001)

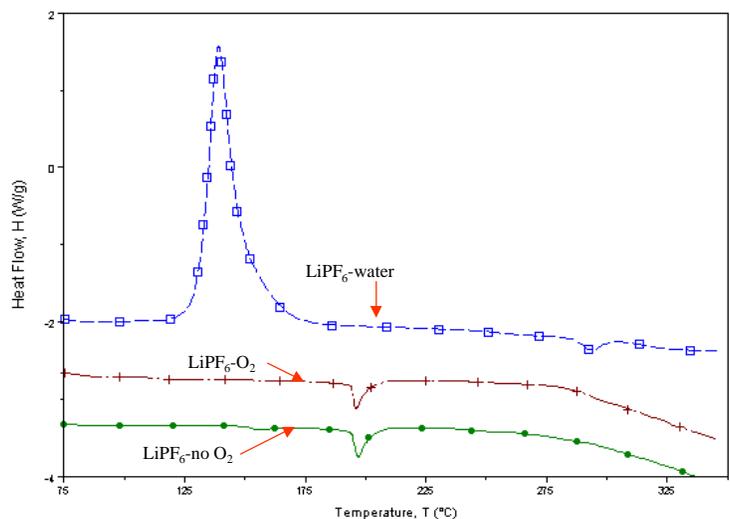


Figure 1. Effect of water and oxygen on the thermal stability of solid LiPF_6 prepared three different ways: 1. Solid LiPF_6 -no O_2 was prepared in an Ar glove box (with maximum 20 ppm of O_2), 2. Solid LiPF_6 - O_2 was prepared in the dry room (with O_2 at atmospheric conditions), and 3. LiPF_6 -water indicates LiPF_6 with 64.5% wt of H_2O .