Abs. 339, 206th Meeting, © 2004 The Electrochemical Society, Inc.

Compatibility of Electrode Materials with LiBOB-Based Electrolytes

Margret Wohlfahrt-Mehrens [1,*], Mario Wachtler [1], Sandra Ströbele [1], Jan-Christoph Panitz [2], and Ulrich Wietelmann [2]

[1] ZSW – Center for Solar Energy and Hydrogen Research, Helmholtzstr. 8, D-89081 Ulm, Germany

[2] Chemetall GmbH, Trakehner Straße 3, D-60487 Frankfurt a.M., Germany

* margret.wohlfahrt-mehrens@zsw-bw.de

Lithium bis(oxalato)borate (LiBOB) is a promising new electrolyte salt for lithium batteries, as it is a fluorine-free, non-toxic, and low-cost alternative to $LiPF_6$ [1,2]. Accordingly, at the moment a lot of research effort goes into the investigation of the compatibility of LiBOB with the various electrode materials and electrolyte solvents and of its performance and safety (e.g. [3-7]). One interesting feature is that at the anode side LiBOB acts as film (SEI) forming compound by itself, which allows the use of PC-based electrolytes in combination with graphitic carbons [3]. For the present contribution the electrochemical performance of different electrode materials in LiBOB-containing electrolytes has been studied in more detail in view of the filming processes.

Fig. 1 shows the typical CV response of a graphitic anode in a LiBOB-based electrolyte. In the first cycle a well resolved reductive peak is observed at around 1750 mV vs. Li/Li^+; beyond, the current does not return to zero, and electrolyte reduction and film formation continue down to potentials where intercalation of Li into graphite occurs.

For carbon materials of the same type but with different surface area, the intensity of the 1.75 V peak increases with the surface area (Fig. 2). However, it is not solely a function of the surface area but also of the surface chemistry, as illustrated by the comparison of different carbon materials. Furthermore, the peak is not a unique feature of carbonaceous anodes but is also observed for other anode materials such as $Li_4Ti_5O_{12}$ (Fig. 3). This fact, together with the finding that the intensity of the 1.75 V peak can be reduced by pre-treating the electrode with n-BuLi, allows the conclusion that it is generally related with reactive surface groups, probably oxygen-containing functionalities.

Based on these results, the influence of possible impurities and additives on the filming behaviour of LiBOB-based electrolytes has been studied.

References

[1] U. Wietelmann, J.-C. Panitz, 21st Int. Battery Seminar & Exhibit, Fort Lauderdale, FL, USA, 08-11 March 2004.
[2] LiBOB, Technical Brochure, Chemetall, March 2004.
[3] K. Xu, S.S. Zhang, B.A. Poese, T.R. Jow, Electrochem. Solid-State Lett. 5, A259 (2002).
[4] K. Xu, S.S. Zhang, T.R. Jow, W. Xu, C.A. Angell, Electrochem. Solid-State Lett. 5, A26 (2002).
[5] J. Jiang, J.R. Dahn, Electrochem. Solid-State Lett. 6, A180 (2003).
[6] J. Jiang, J.R. Dahn, Electrochem. Comm. 6, 39 (2004).
[7] K. Xu, U. Lee, S.S. Zhang, M. Wood, T.R. Jow, Electrochem. Solid-State Lett. 6, A144 (2003).

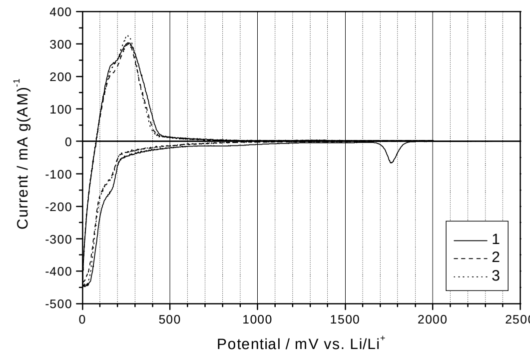

Fig. 1: First three CV cycles of a MCMB 10-28 electrode in LiBOB / EC-EMC.

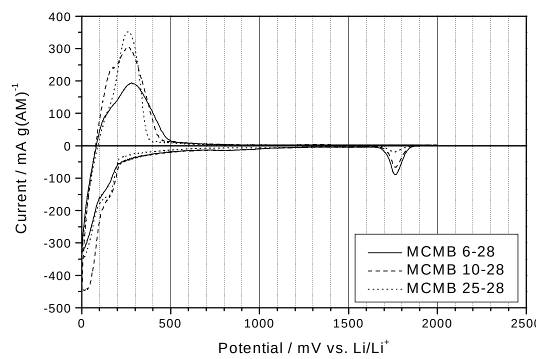

Fig. 2: Comparison of the first CV cycles of different MCMB electrodes (the surface area increases in the order 25-28 < 10-28 < 6-28) in LiBOB / EC-EMC.

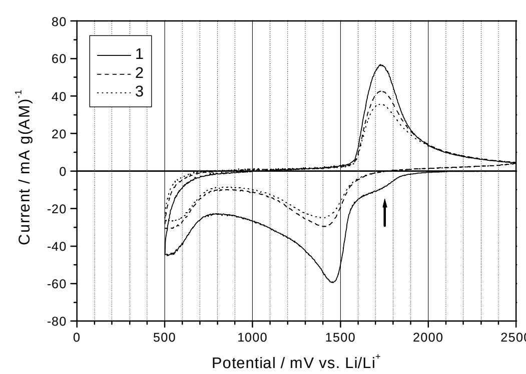

Fig. 3: First three CV cycles of a $Li_4Ti_5O_{12}$ electrode (using Ni as conductive additive) in LiBOB / EC-EMC.