

Electrolyte Decomposition

On Chemically And Electrochemically Formed Li-Intermetallics

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Due to their high theoretical volumetric capacities, intermetallic phases are of special interest as negative active masses for miniaturized secondary lithium batteries even though the problem of fading capacities linked to great volume changes during (de)lithiation [1] is still not solved completely despite different strategies are being approached [2,3,4]. The present work deals with the gas evaluation due to electrolyte decomposition that occurs during the formation of Li-intermetallics thus providing an insight into the formation mechanism of these compounds.

To synthesize the Li-intermetallics, two different strategies are being followed. Firstly, it is created by electrochemical lithiation of the host metal. Secondly, it is formed by chemical Li⁺-insertion. The experiments are carried out in different electrolytes, including LiClO₄ in propylene carbonate (abbr.: PC, 1M) and in ethylene carbonate (abbr.: EC, saturated). The formation of the intermetallic phase is confirmed by recording its potential vs. Li/Li⁺ over time. Afterwards, head space analysis of the evolved gas is performed via GC-FID and MS.

The formation of an intermetallic compound evolves gas of varying composition depending on the used solvents. Head space analyses performed by GC-FID show significant amounts of evolved hydrocarbons for both solvents, PC and EC with those for EC being considerably larger. MS-spectra of the waste gases' volume do not show any evolved carbon dioxide. The experiments indicate solvent reduction towards volatile hydrocarbons and specific solid carbonates, the latter being a solid electrolyte interphase component.

References:

- [1] J.O.Besenhard, J.Yang, M.Winter, *J.Power Sources* 1997, 68,87.
- [2] R.A. Huggins, *Lithium Batteries* 2004, 270-296.
- [3] J.Yang, M. Wachtler, M. Winter, J.O.Besenhard, *Electrochem. Solid State Lett.* 1999, 2, 61.
- [4] M. Wachtler, M. Winter, J.O.Besenhard, *J.Power Sources* 2002, 105, 151.