

Exploring the electrochemical behavior of InSb as negative electrode for Mg-ion batteries

M. Gauthier, L. Blondeau, E. Foy, S. Surblé, H. Khodja

NIMBE, CEA, CNRS, Université Paris-Saclay, CEA Saclay 91191 Gif-sur-Yvette
France

E-mail: magali.gauthier@cea.fr

Magnesium metal has a tendency to react with conventional electrolytes to form a barrier on its surface[1], rendering cations exchange impossible, and thus dramatically limiting reversible stripping/deposition of Mg. Unlike Mg metal, alloys based on p-block elements (Sn, Sb, In, Pb, Bi) do not appear to suffer from the formation of a blocking passivation layer in conventional electrolytes. These substitute electrodes appear therefore as a promising solution to overcome the problem of compatibility with electrolytes, even if the reaction mechanisms behind their operation in conventional electrolytes are still unsolved.

In order to improve the performance of these electrodes, we evaluated a possible synergy effect between p-block elements, as already shown for SnSb[2] and BiSb[3]. We chose to work on InSb that may combine the high theoretical capacity of Sb and the lowest working potential reported for In. InSb, synthesized by ball-milling, shows an electrochemical behavior (Figure 1) drastically different from those of the lone elements. We will demonstrate that the combination of In and Sb is beneficial as it promotes the reactivity of Sb, similarly to BiSb alloy[3]. Structural and morphological ex situ characterization will also be described in details and correlated with the peculiar electrochemical behavior of InSb.

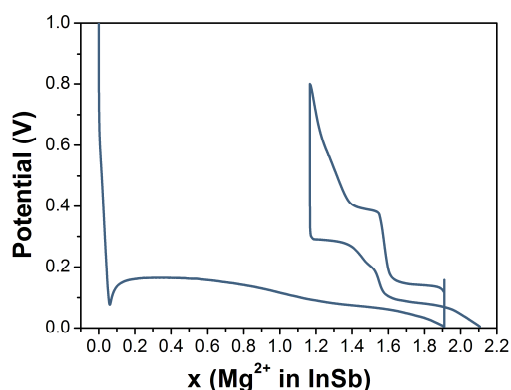


Figure 1: Voltage profile of an InSb-based electrode cycled at a rate of C/100 in an electrolyte based of EtMgCl and Et₂AlCl in THF.

References

- [1] Yoo, H. D., Shterenberg, I., Gofer, Y., Gershinshy, G., Pour, N., Aurbach, D. Mg rechargeable batteries: an on-going challenge. *Energy Environ. Sci.* **2013**, 6, 2265–2279.
- [2] Cheng, Y., Shao, Y., Parent, L.R., Sushko, M.L., Browning, N.D., Wang, C., Liu, J. Interface Promoted Reversible Mg Insertion in Nanostructured Tin–Antimony Alloys. *Adv. Mater.* **2015**, 27, 6598–6605.
- [3] Murgia, F., Laurencin, D., Weldekidan, E.T., Stievano, L., Monconduit, L., Doublet, M-L., Berthelot, R. Electrochemical Mg alloying properties along the Sb_{1-x}Bi_x solid solution. *Electrochim. Acta.* **2017**, 259, 276–283.