Design of Electrode / Electrolyte Interphase for Rechargeable Magnesium Batteries

M. Matsui

Department of Chemical Science and Engineering, Kobe University
E-mail: matsui@godzilla.kobe-u.ac.jp

Rechargeable magnesium batteries are expected as potential beyond lithium ion systems, because of their high theoretical capacity densities owing to the divalent magnesium ion. One of the biggest challenges of the magnesium-based negative electrode is passivation of the electrode surface. We have been working on a magnesium-based intermetallic compound Mg_3Bi_2 Zintl phase as a potential anode active material for the magnesium-ion batteries, because the Mg_3Bi_2 anode has relatively high volumetric capacity of 1906 mAh cm^{-3} and is compatible with conventional ionic electrolyte solutions such as magnesium bis(trifluoromethane sulfonyl amide) ($Mg(TFSA)_2$) dissolved in acetonitrile (AN) solution.

Here we synthesized the Mg_3Bi_2 and the Mg_3Sb_2 powders via conventional solid state process. The Mg_3Bi_2 electrode shows excellent reversibility as reported [1]. On the other hand, the Mg_3Sb_2 shows poor reversibility as shown in Figure 1. We think the reversibility of the intermetallic anode represents the "SURFACE and BULK INSTABILITY", because the Mg_3Bi_2 powder shows hydrolysis in ambient atmosphere, while the Mg_3Sb_2 is extremely stable even with excess H_2O. We also investigated the compatibility of the Mg_3Bi_2 with various electrolyte solutions. The Mg_3Bi_2 shows good reversibility in ether-based and mono-nitril solvents containing $Mg(TFSA)_2$.

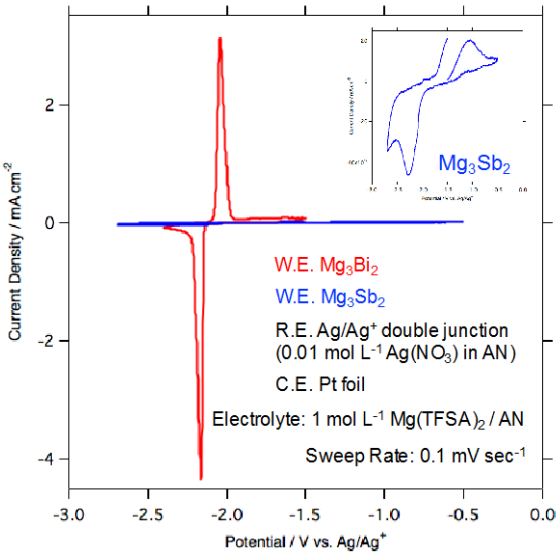

Figure 1: Electrochemical activity of Mg_3Bi_2 (red) and Mg_3Sb_2 (blue and inset) in $Mg(TFSA)_2$-AN solution

References

[1] Timothy Arthur, Masaki Matsui, and Nikhilendra Singh, *Electrochemistry Communications,* **16**, 103-106 (2012)