Diffusional Transformations of InSb Electrodes in Lithium Cells

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InSb has shown promise as an alternative negative electrode for lithium cells in terms of its comparable gravimetric capacity and superior volumetric capacity compared to carbon based electrodes. The shape of the charge/discharge voltage profile of Li/InSb cells is complex, asymmetric under high rates and sensitive to the magnitude of the current. Under OCV conditions, however, the general shape and voltages of the curves (Fig. 1) in the first 2 cycles are very similar, although the lengths of the plateaus vary. In this presentation, the electrochemical behavior of the InSb electrodes is considered in the light of microstructural analysis. Results from x-ray diffraction, transmission electron microscopy and scanning electron microscopy indicate that the discharge of InSb electrodes versus Li results in the displacement of a fraction of the In from the zinc-blende crystal lattice. As is shown in Fig. 2, the In is extruded from the InSb structure as long whiskers which appear to extend from one residual InSb particle to the next. The role of long range, solid-state diffusion of In and Li in the appearance of the charge/discharge profile is examined from the point of view of the kinetics of solid-state phase transformations. Factors controlling the morphological development of the displaced In is also considered.

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References

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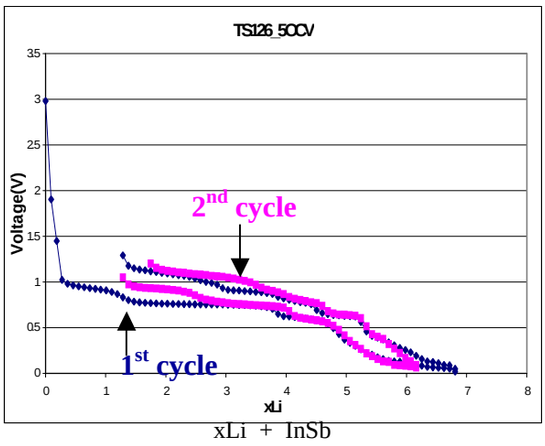

Fig. 1. First 2 cycles of InSb under OCV conditions.

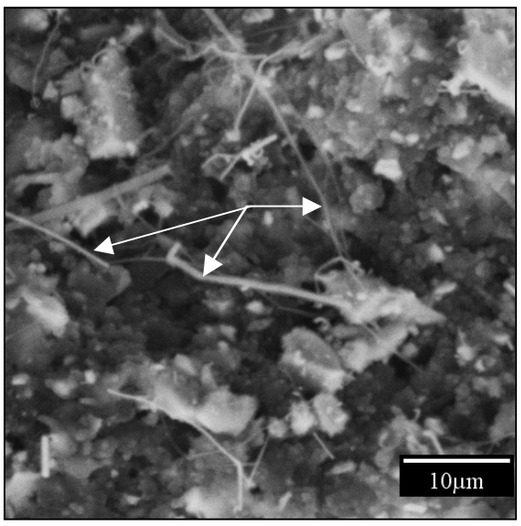

Fig. 2. SEM micrograph of cycled InSb with In wires indicated.