Optical Observations of Amorphous Metallic Alloy / Polymer Composite Electrodes

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Negative electrodes made from amorphous metallic alloys are considered to be good candidates to replace those made from graphite because they have much greater capacities. [1] Unfortunately, their capacity retention is considerably worse [1]. Although amorphous alloy particles themselves do not lose capacity during charge-discharge cycling [2], the composite electrode does because the polymer used to bind the particles is incapable of accommodating the 250% [3] volumetric expansion and contraction of the alloys [4]. New elastomeric binder systems have been developed that are capable of accommodating the huge volumetric changes over ~100 cycles [5].

In order to "see" why there is improved cycling performance, and why there is still some capacity loss, an optical microscope with an attached webcam, as Figures 1 and 2 show, has been used to observe the electrodes as they charge and discharge *in situ*. As Figure 3 shows, the changes in the electrodes are recorded as time-lapsed movies whose time indices are synchronized to simultaneously collected voltage data.

The system currently has a magnification of 200X which allows qualitative features of the volume changes to be observed. Over the next month an upgrade to 1250X magnification will be completed that will allow quantitative measurements of particle volume, crack frequency, inter-particle collisions, and particle motion to be made. It is our intention to have results at 1250X magnification available at the conference.

The results from the optical and related experiments on a-$Si_{0.64}Sn_{0.36}$ and other electrode materials will be presented.

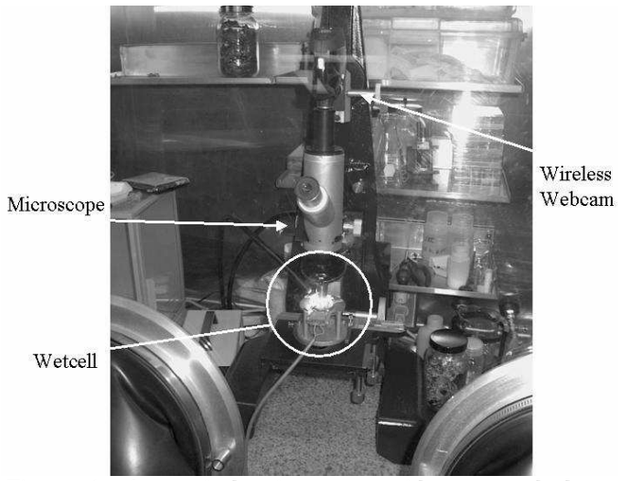

Figure 1. An optical microscope with an attached wireless webcam images an electrode reacting with Li metal in an open wetcell in an argon filled glovebox.

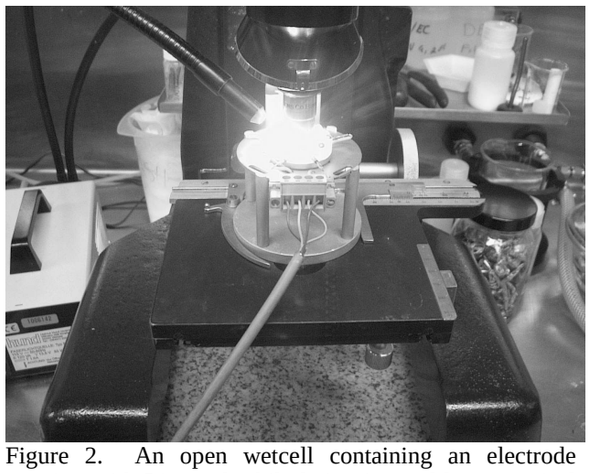

Figure 2. An open wetcell containing an electrode reacting with Li metal while being imaged by an optical microscope and being illuminated by a fiber optic light source.

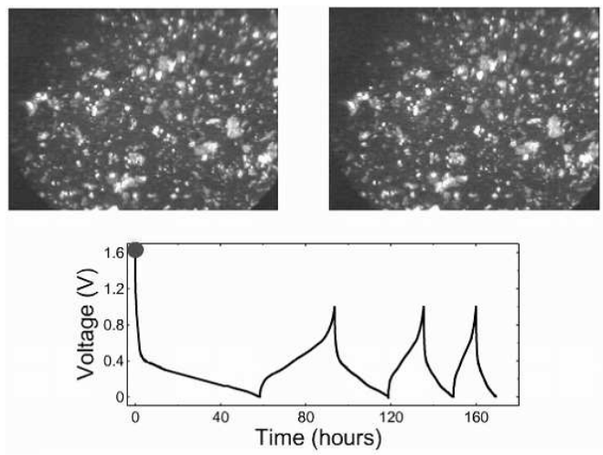

Figure 3. The first still frame from the time lapsed movie and associated voltage vs. time curve of an a-$Si_{0.64}Sn_{0.36}$ electrode's morphology when cycled vs. Li metal.

References:

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