

## FALL, 2005 SABBATICAL LEAVE REPORT

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### ACHIEVEMENTS

During my Fall, 2005 Sabbatical leave, the following was accomplished:

- 1) INS (Inelastic Neutron Scattering) continuation proposal written and submitted for beam time at the Intense Pulsed Neutron Source (IPNS) at the Argonne National Laboratory (ANL) (DOE):  
This was successful, and 8 days of beam time were granted for June, 2005.<sup>1</sup>
- 2) C<sub>2</sub>E<sub>2</sub> proposal written for up-grading MTU Raman system”:  
This was funded for a total of \$20,600, including matching funds from two departments, individual accounts, the Dean of S & A, and \$5000 from C<sub>2</sub>E<sub>2</sub>.<sup>2</sup>
- 3) Preliminary INS experiments conducted:  
These were conducted over 4 days at the IPNS at ANL, near Chicago, IL (3-6 Nov. 2004).
- 4) Collaboration with Drs. Michael Thackeray and Chris Johnson at ANL:  
While at ANL in Nov. 2004, I met with Drs. Michael Thackeray and Chris Johnson, (Electrochemists at ANL) and arranged a collaboration with them. This involves work proposed in research proposals (see items 6 and 8) and begun, in part, while I was at the U. of South Carolina.
- 5) Travel to University of South Carolina, Columbia, for collaboration with Prof. John Weidner, Dept. of Chemical Engineering:  
This time together (Nov.-Dec.) has allowed us to continue and expand our collaboration. (Some of our earlier research work appears in a recent publication.<sup>3</sup>) While there, I also collected an extensive amount of spectroscopic data on Li-ion and Ni electrode battery materials as well as for several minerals. This was done with the kind cooperation of Dr. Christopher T. Williams at USC. An *in situ* Raman cell was designed while there.
- 6) Proposal written while at Univ. of South Carolina for study of Li-ion battery cathodes, and submitted to BATT (Batteries for Advanced Transportation Technologies), Berkeley Labs (DOE) (not funded):  
This proposal included Professors S. Hackney and W. Perger, as Co-PI's.<sup>4</sup>

The sabbatical allowed us to set the stage for the following, on-going research opportunities:

- 7) The INS data collected for two battery materials in Nov. 2004 at the IPNS (#3 above) (4 days of instrument time) has served as “proof of concept” for our continued experiments there. These experiments, though preliminary, were crucial in that they have lead to 8 days of instrument time (June 8-16) and a recent continuation proposal for 12 more days in the second half of 2005.<sup>5</sup> Two students, Carlos Baiz (senior) and Ming Ning (grad. Student), will accompany me for the June trip to ANL. (The IPNS

at ANL has graciously supported our stays there by covering our lodging at the Guest House at ANL, both in Nov. '04 and June, '05.)

- 8) Furthermore, an enhanced Li-ion battery proposal is in progress and will be submitted to DOE/BES (Basic Energy Sciences), Washington, DC, in the near future. This proposal will include Professors S. Hackney, W. Perger, and J. Weidner, U. So. Carolina, as Co-PI's.

## SUMMARY

In short, although the experimental work at the IPNS prevented me from leaving for the University of South Carolina as soon as originally proposed, the sabbatical allowed extensive proposal development in a new research area (items 6 & 8), the first step toward up-grading our Raman lab, lively and enjoyable collaboration with faculty at the Univ. of South Carolina and at ANL, and extensive data collection while at both locations. I feel the time was spent productively and has led to new research opportunities. I thank the Sabbatical Leave Committee and all those at MTU who have played a role in allowing me this opportunity.

## REFERENCES

1. "Structural Study of Proton Positions in Nickel Electrode Materials," Proposal for 8 days instrument time in Jan.-June, 2005, to IPNS, ANL (DOE), Sept. 30, 2004 (funded).
2. "Upgrade to a General-Use Campus Raman Facility," C<sub>2</sub>E<sub>2</sub> Proposal, Oct. 24, 2004.
3. V. Srinivasan, B. C. Cornilsen, and J. W. Weidner, "A Nonstoichiometric Structural Model to Characterize Changes in the Nickel Hydroxide Electrode during Cycling," *Journal of Solid State Electrochemistry*, **9**, 61-76 (2005).
4. "Characterization of the Cathode Structures and Nonstoichiometry to Improve Properties of the Mn-containing, Li-ion, Baseline Cathodes," BATT/Berkeley/DOE (not funded).
5. "Structural Study of Proton Positions in Nickel Electrode Materials (continuation proposal)," Proposal for 12 days instrument time in Aug.-Dec., 2005, to IPNS, ANL (DOE), May, 2004 (pending).