Re-Thinking Lithium Ion Battery Design and Manufacturing

Yet-Ming Chiang[1,2]
[1]*Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge MA 02139*
[2]*24M Technologies, Inc., Cambridge MA 02139*

ychiang@mit.edu

A multiyear research and development effort at MIT and 24M Technologies has demonstrated a new lithium-ion cell architecture and manufacturing method based on semisolid electrodes. Originally studied for flow battery applications, semisolid electrodes have been developed with high electronic conductivity (t_e~1) and lower tortuosity than conventional calendered electrodes, thereby allowing thick electrodes with several times the thickness and area capacity of today's lithium ion electrodes to have transport kinetics useful for all but very high power applications. Figure 1 illustrates the area capacity (mAh/cm^2) of semisolid Li-ion cells compared to several conventional cells as a function of current density, with the diagonal lines indicating constant C-rate contours. Cells built on this electrode platform have significantly fewer inactive component layers than conventional lithium-ion cells of similar performance, and can be produced by a radically simpler process that obviates most of the electrode fabrication unit operations in conventional Li-ion, thereby lowering both materials and manufacturing cost. Semisolid Li-ion cells also possess unique physical properties including deformability and high abuse tolerance. Cell test results for LFP/graphite grid cells and NCA and NMC based EV cells will be presented.

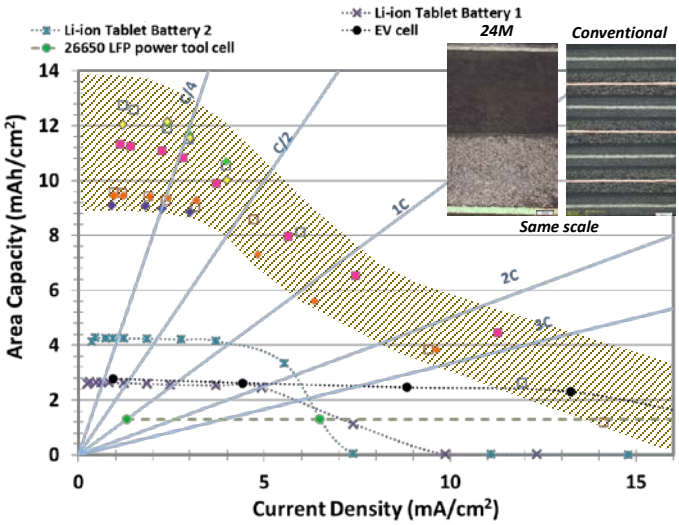

Figure 1. Area capacity vs. current density for semisolid electrodes (shaded band) and several conventional Li-ion cells. Inset shows cross-sections of semisolid cell stack compared with conventional cell at the same magnification.

Acknowledgements:

Support by the U.S. Department of Energy through the ARPA-E program, the Vehicle Technologies Office of EERE, and the Advanced Battery Materials Research (BMR) program is gratefully acknowledged.