Sodium Intercalation Battery for Stationary Storage

Energy Storage Systems Program (ESS)
Peer Review and Update Meeting 2012

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Washington DC,
September 27, 2012

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Large-scale stationary energy storage for integration with renewables and for off-peak energy capture is a new application requiring new rechargeable batteries.

- New combination of requirements
  - Long cycle life under deep cycling use profile
  - High cycling efficiency
  - Moderate rate capability
  - Very low cost
  - **No** requirement for particularly high specific energy or energy density
- TIAX is developing a novel Na-ion battery
  - Leverages teachings of Li-ion technology
  - Targets novel low-cost chemistry and cell design
- TIAX has an ongoing Phase I SBIR program
  - contract # DE-SC0006457

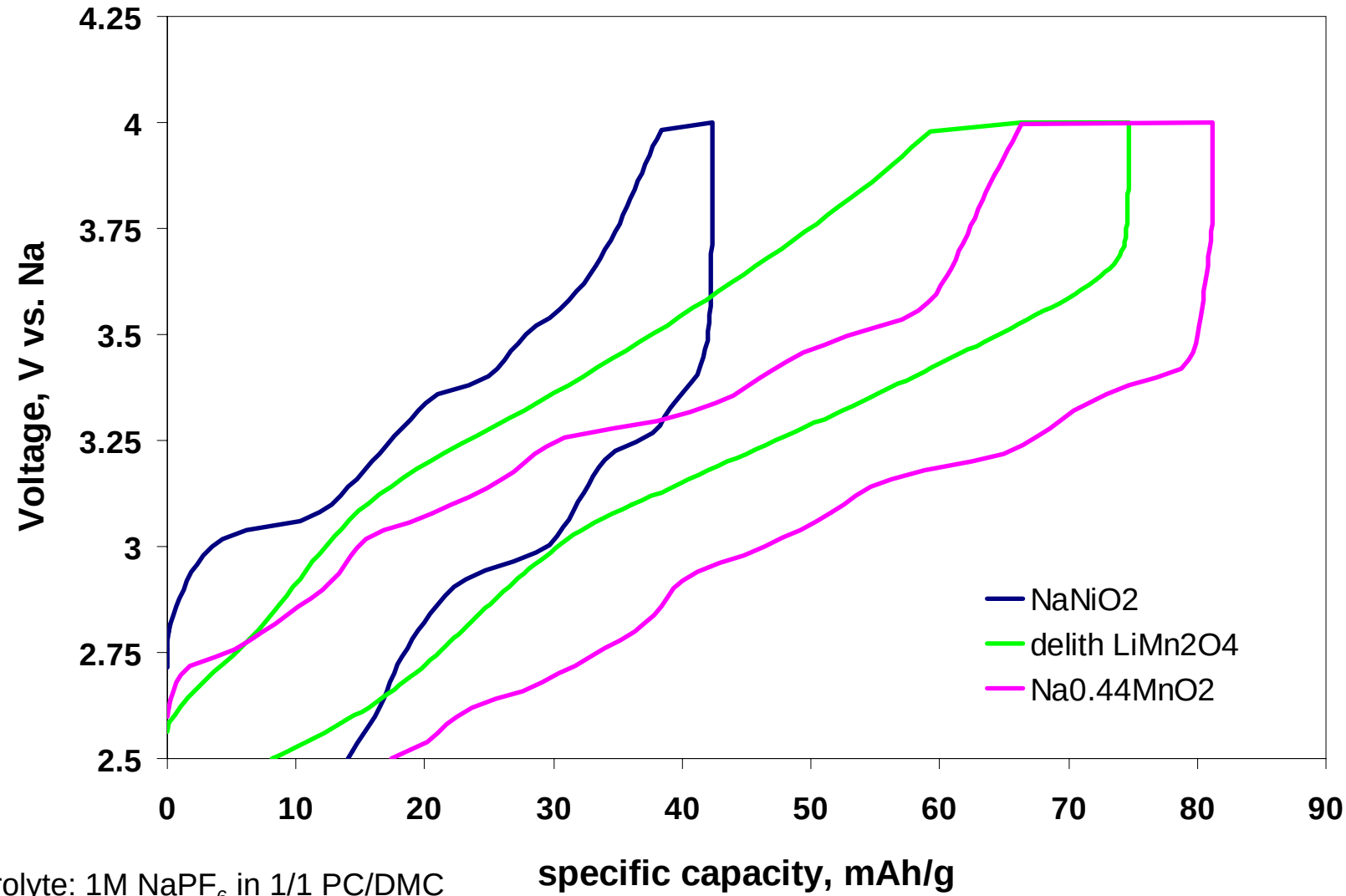
TIAX is integrating elements of other technologies for this energy storage application.

- Screen materials vs. Na metal counter-electrode in Na^+ salt-based organic electrolyte
  - Evaluate known Na-ion active materials
  - Evaluate Na analogues of Li-ion active materials
  - Pair anode and cathode materials for combining in Na-ion cells.
- Formulate Na^+ electrolyte for enhanced Na-ion performance.
- Formulate electrodes for enhanced performance in Na^+ electrolyte.
- Demonstrate baseline cell chemistry.
- Develop scaled-up cell designs and rough cost estimates.
- TIAX has an ongoing Phase I SBIR program
  - contract # DE-SC0007475.

Initial anode and cathode materials have been cycled vs. Na metal in organic Na^+ electrolyte.

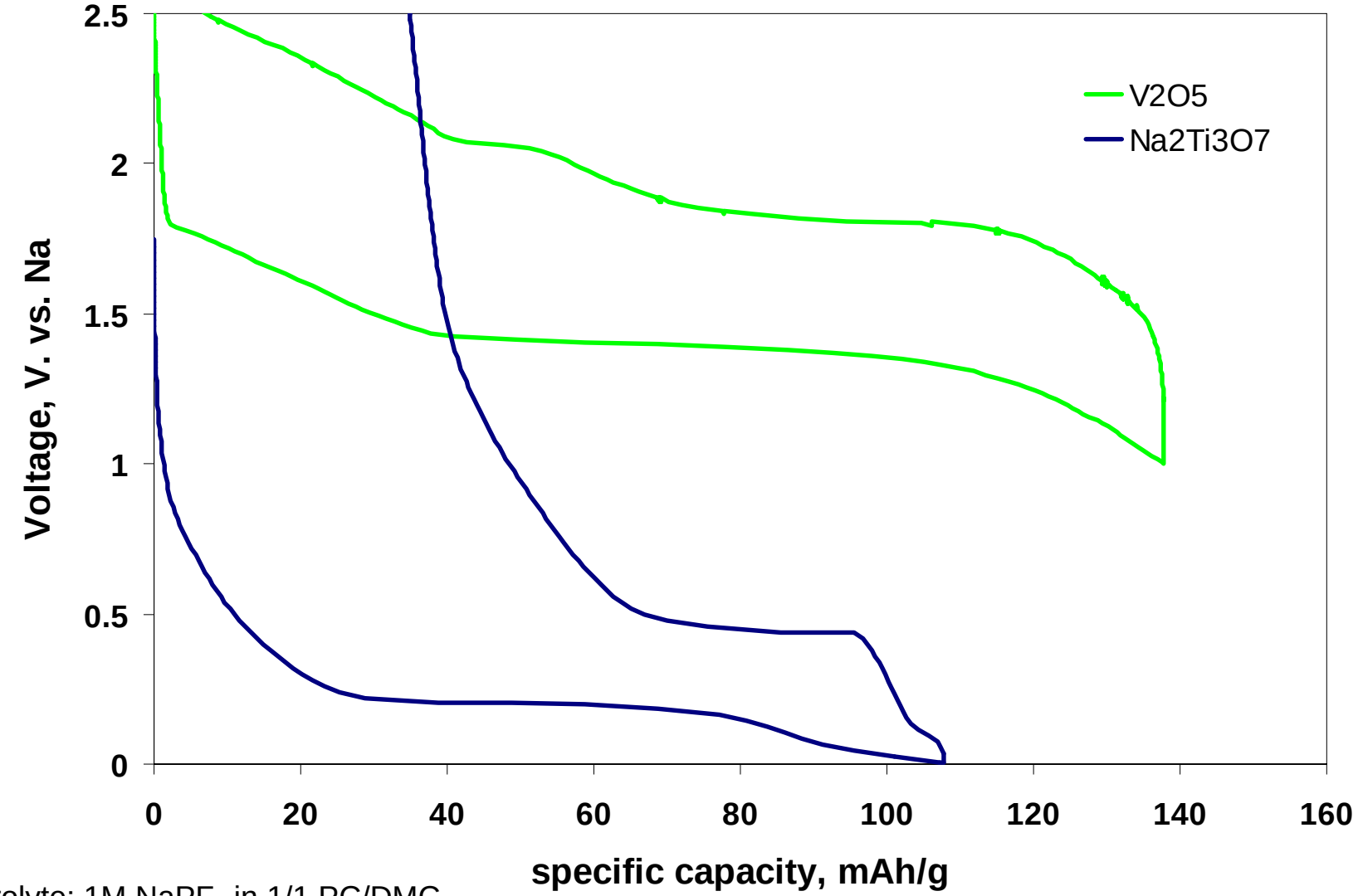
material	average potential V vs. Na	specific capacity mAh/g
cathodes		
$Na_{0.44}MnO_2$	3.2	65
$NaNiO_2$	3.1	30
delith $LiMn_2O_4$	3.4	70
anodes		
$Na_2Ti_3O_7$	0.32	90
V_2O_5	1.6	140

Cathode materials investigated to date cycle at slightly lower potentials than their lithium analogs ($E^{Na/Na+}$ = 0.25V vs. $E^{Li/Li+}$).



Electrolyte: 1M $NaPF_6$ in 1/1 PC/DMC

Possible anode choices span a broad range of cycling potentials.



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Our Phase I SBIR program is now entering into tests of full cell chemistries.

- Candidate active materials screened
  - Additional candidates are still on test.
- Electrolyte formulation experiments are underway.
- Na-ion cell experiments are beginning.