



Program for **1st International Conference on Advanced Lithium Batteries for Automobile Applications**

Hosted by
Argonne
National
Laboratory,
U.S.
Department
of Energy

[Talks >>](#)
[Posters >>](#)
[Sponsors >>](#)
[Attendee List >>](#)

September 15-17, 2008



U.S. Department of Energy
Energy Efficiency and Renewable Energy

Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

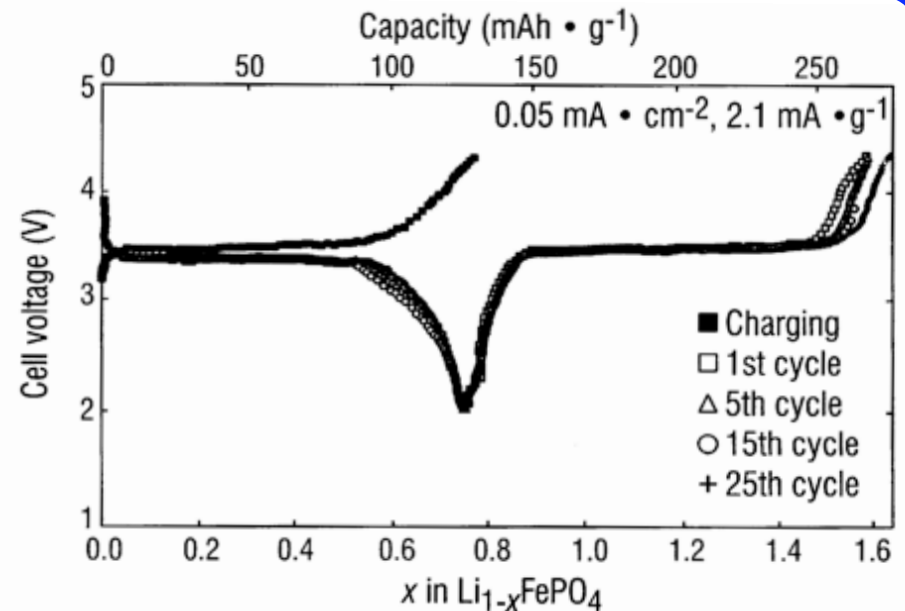
Phostech, a 100% subsidiary of Süd-Chemie AG

*Based on strong material and process patents/ applications, including **exclusive license of Hydro-Québec and Texas University**, Phostech produces and sells LiFePO_4*

Exclusive HQ/UT license

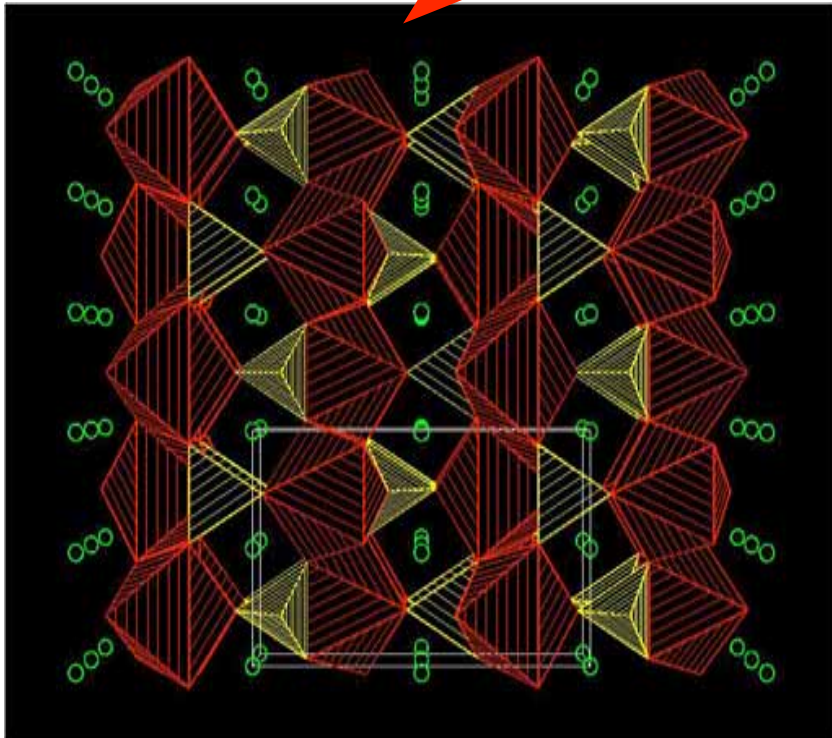
US 5,910,382 (Prof. J. Goodenough)
Application as cathode material

US 6,514,640 (Prof. J. Goodenough)
Optionally doped



LiFePO₄ Olivine Cathode Material

Li-extraction with preservation of structure and specific volume
⇒ High cycle stability 😊



theoretical capacity: 169mAh/g
practical capacity: 155mAh/g

⇒ < 10% Li-surplus in cell

⇒ High tolerance versus over-charge 😊

Cell voltage:

+3,45V vs. Li-metal

+3,2V vs. graphite

⇒ less electrolyte aging 😊

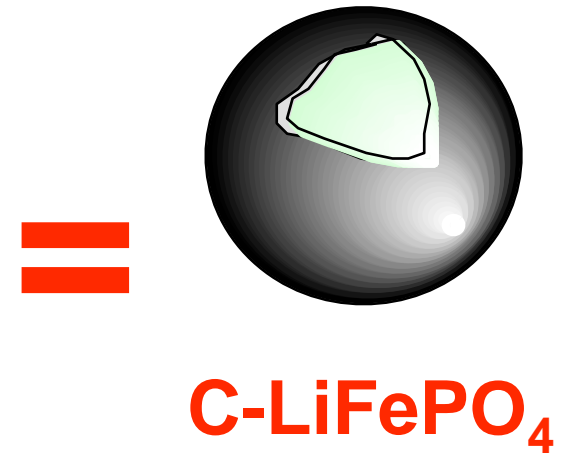
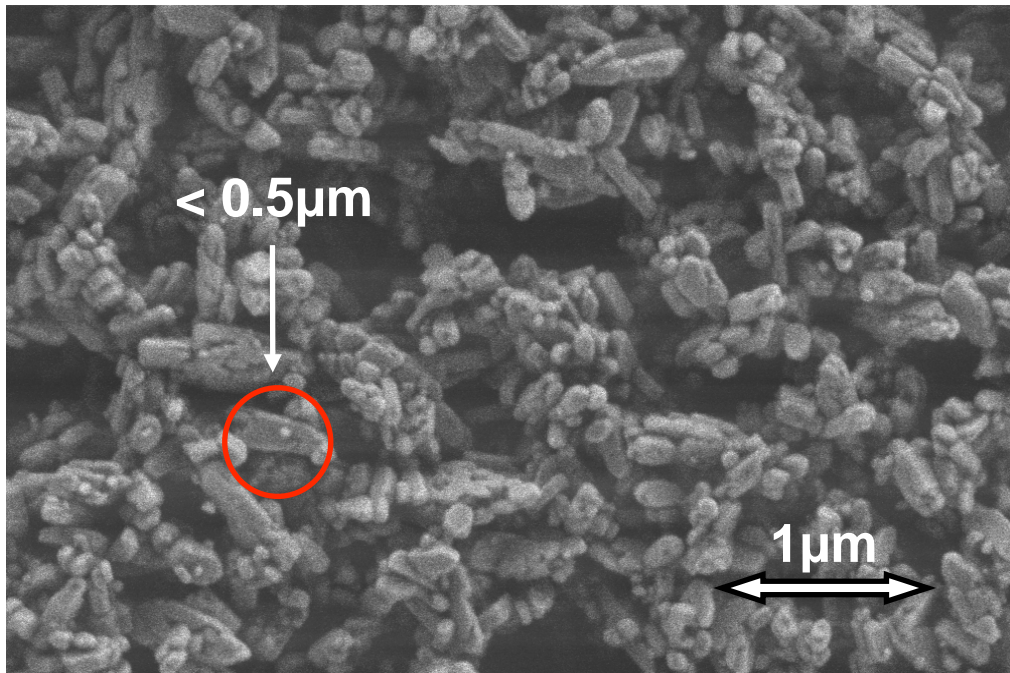
⇒ flat-voltage discharge curve 😊

1-dim. Li⁺-conduction

1-dim. e⁻-conduction

⇒ low bulk conductivity 😞

Measures to overcome kinetic limitation => breakthrough for LiFePO_4



**sub-micron particles + carbon deposit
= high-power capability**

$\text{LiFePO}_4\text{-FePO}_4$ stability



Natural triphylite $\text{LiFe}(+2)\text{PO}_4$



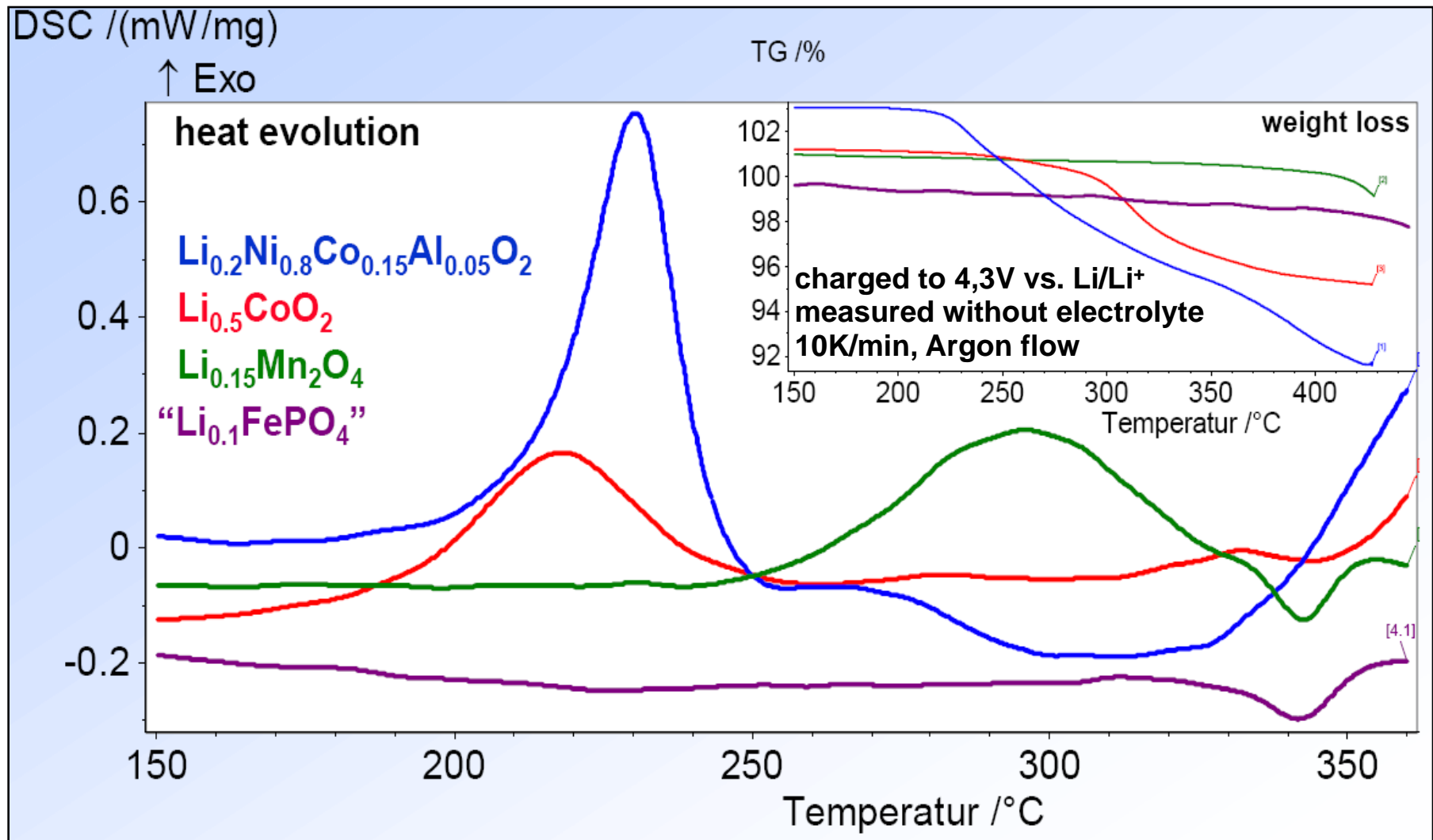
Natural heterosite $\text{Fe}(+3)\text{PO}_4$

Phostech
"molten process" LiFePO_4
made at 1000°C



Thermal stability of Cathode Materials

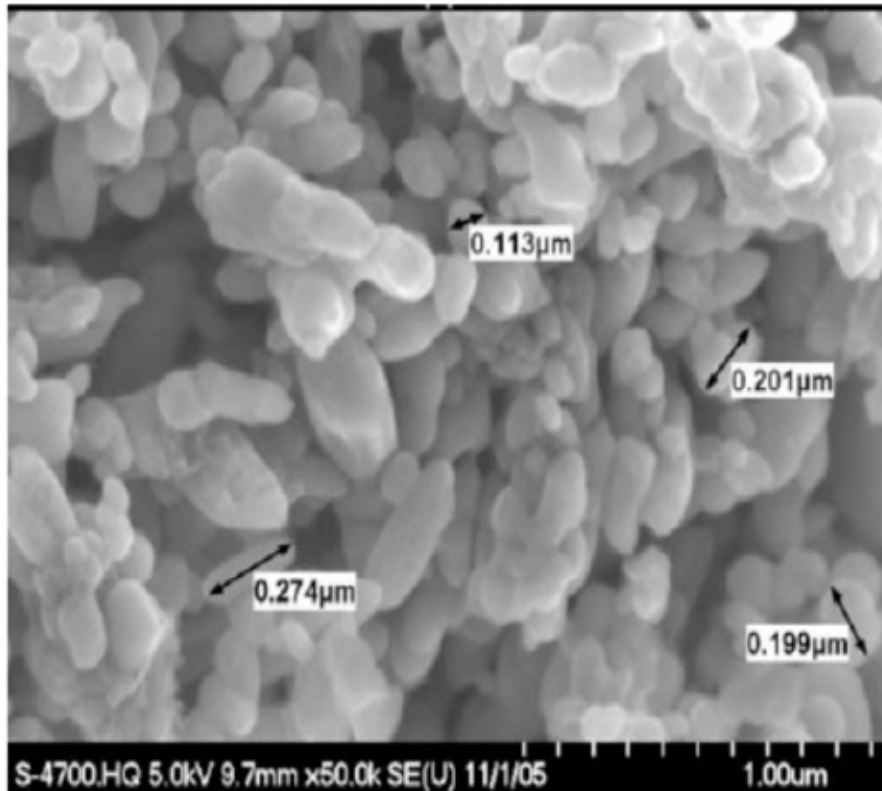
Heat evolution and oxygen loss



measured by ZSW: J. Power Sources 119-121 (2003), 247

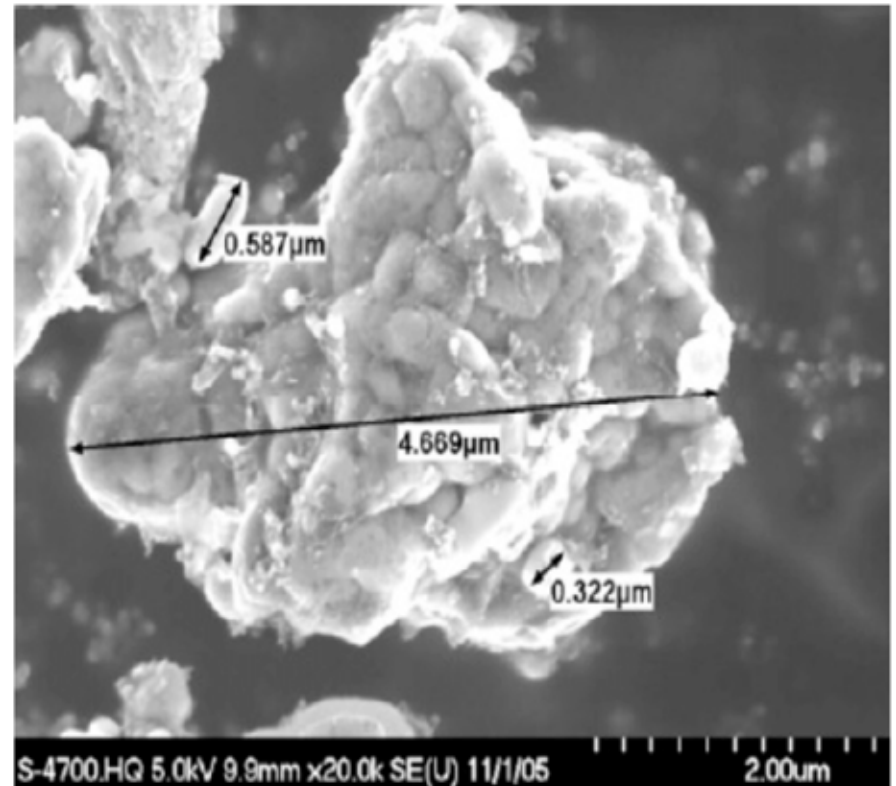
Phostech commercial products

P2 - Power Grade



Nanosized

P1 - Energy Grade



Micro-Aggregates

+ Under-development products to fulfill customers needs

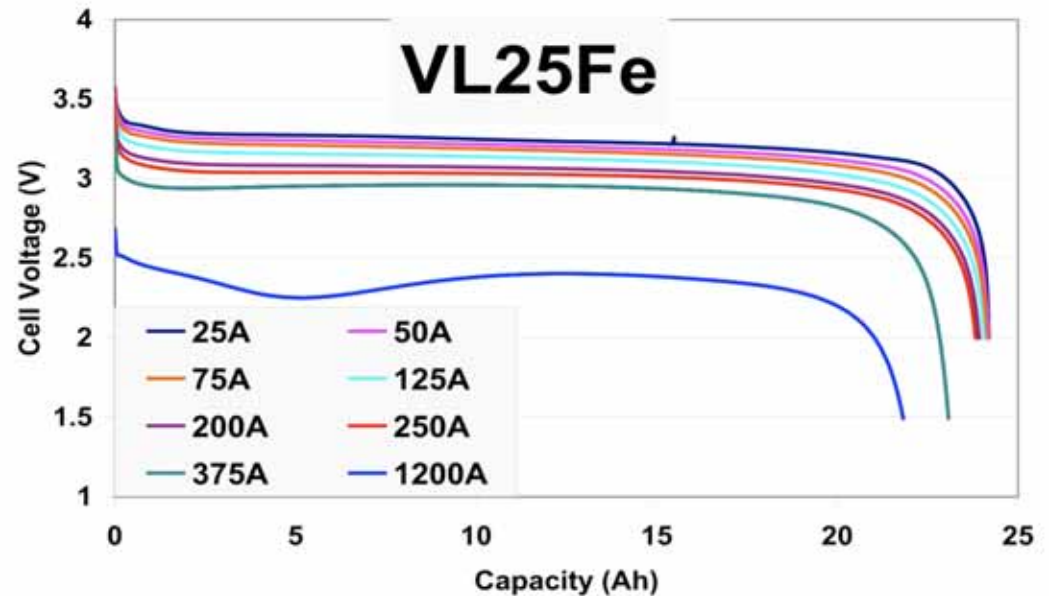
125 Tons combined sales of LiFePO_4 in 2007 !



VL25Fe Cell based on Phostech LiFePO_4



Cell optimized for
Medium Power/Medium Energy
applications



Cell	VL25Fe
Cathode	LiFePO_4
Nominal Voltage (V)	3.3
Nominal Capacity at C rate (Ah)	25
Maximum Discharge Current at 25°C (A)	
Continuous	1200
2s Pulse	2200
200ms pulse	2300
Specific Energy (Wh/kg)	89
Energy Density (Wh/L)	189
Specific Power at 25°C 100% SOC (W/kg)	
Continuous	3150
2s Pulse	4400
200ms Pulse	4600

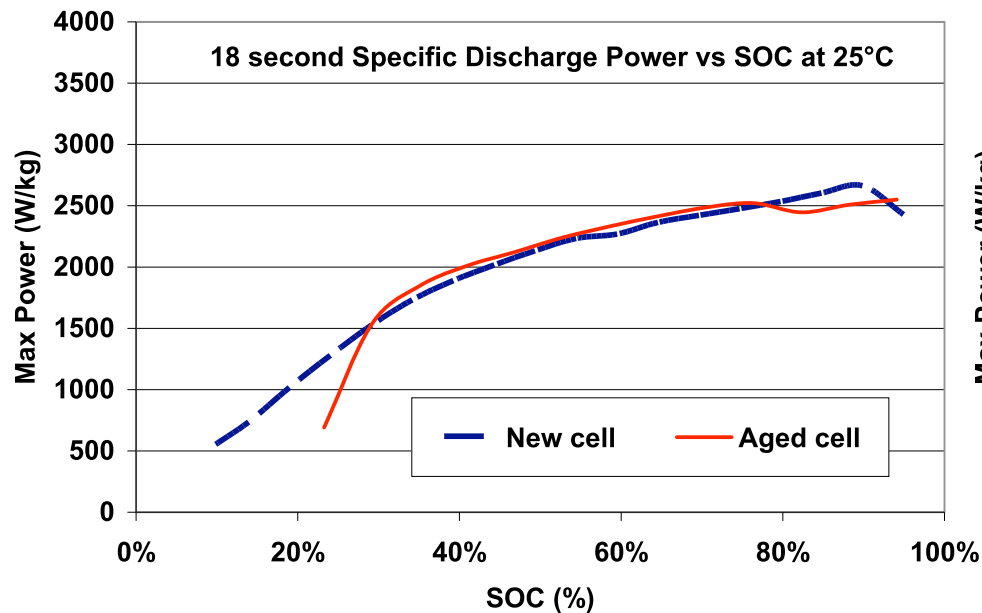


Pulse Power retention with ageing

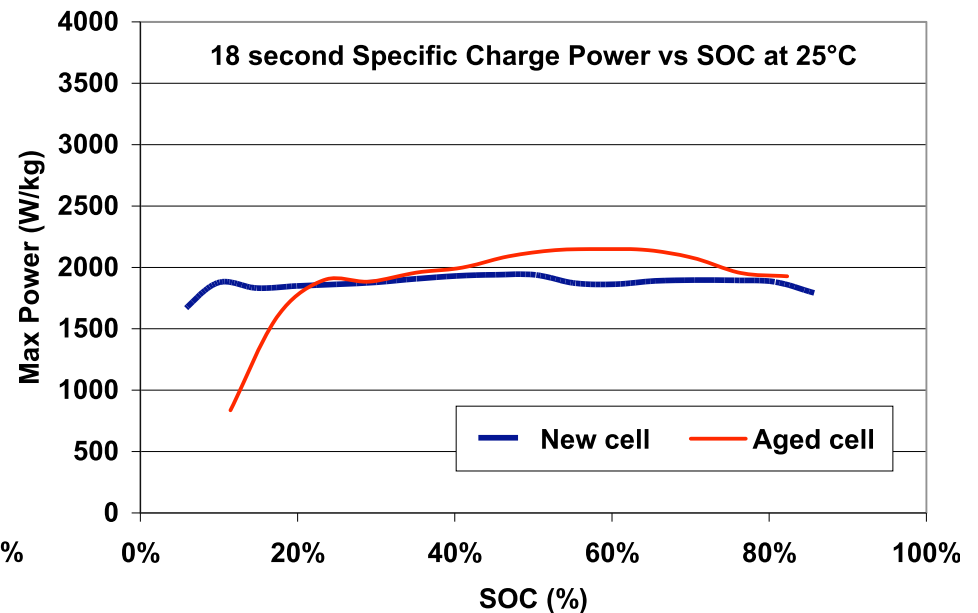
2500 W/kg 18sec Discharge PP @ (70-100)% SOC & 25°C

1900 W/kg 18sec Charge PP @ (20-80)% SOC & 25°C

Nearly no power loss after 700 full cycles @ 1C rate & 60°C



Discharge PP



Charge PP

LiFePO₄ products and applications



12V/24V System
Pat. with charger port



3.2V 23Ah -144Ah
Pat. Prismatic Cell



3.2V 10Ah-250Ah
Pat. Cylindrical Cell





GREENRUNNER® EV

Using The *PHET* World PAT. Fault-Tolerant C-LiFePO₄ (World. Pat.) Battery on the EV made by The *PMMC* (Pihsiang Machinery MFG. Co., LTD.)



ev@pihsiang.com.tw

Model	Slow Speed Urban Car (LQ)			High Speed Urban Car (HQ)		
	Economy	Standard	Long Range	Economy	Standard	Long Range
Capacity						
Maximum Speed (km/h)	45 ~ 50	45 ~ 50	45 ~ 50	64~80	64~80	64~80
Autonomy* (km)	85	100	138	75	93	120
Motor AC (KW)	4	4	4	7.5	7.5	7.5
Charging Time (H) standard plug 230V 30 A	3.5	4.5	6.5	3.5	4.5	6.5

LTC/Gaia PHEV Battery

23 May 2007: +125 mpg PHEV Toyota Prius present in New-York through a Phostech/Gaia partnership !

Gaia has developed a Li-Ion polymer battery produced by a continuous extrusion technology



Attending the premiere of the first car with a new lithium drive: Dr. Klaus Brumm, CEO Lithium Technology Corporation and Managing Director SAH GmbH, Christiaan Van Der Berg, Chairman Lithium Technology Corporation, Michel Sautin, President Phostech Lithium Inc. from the left.



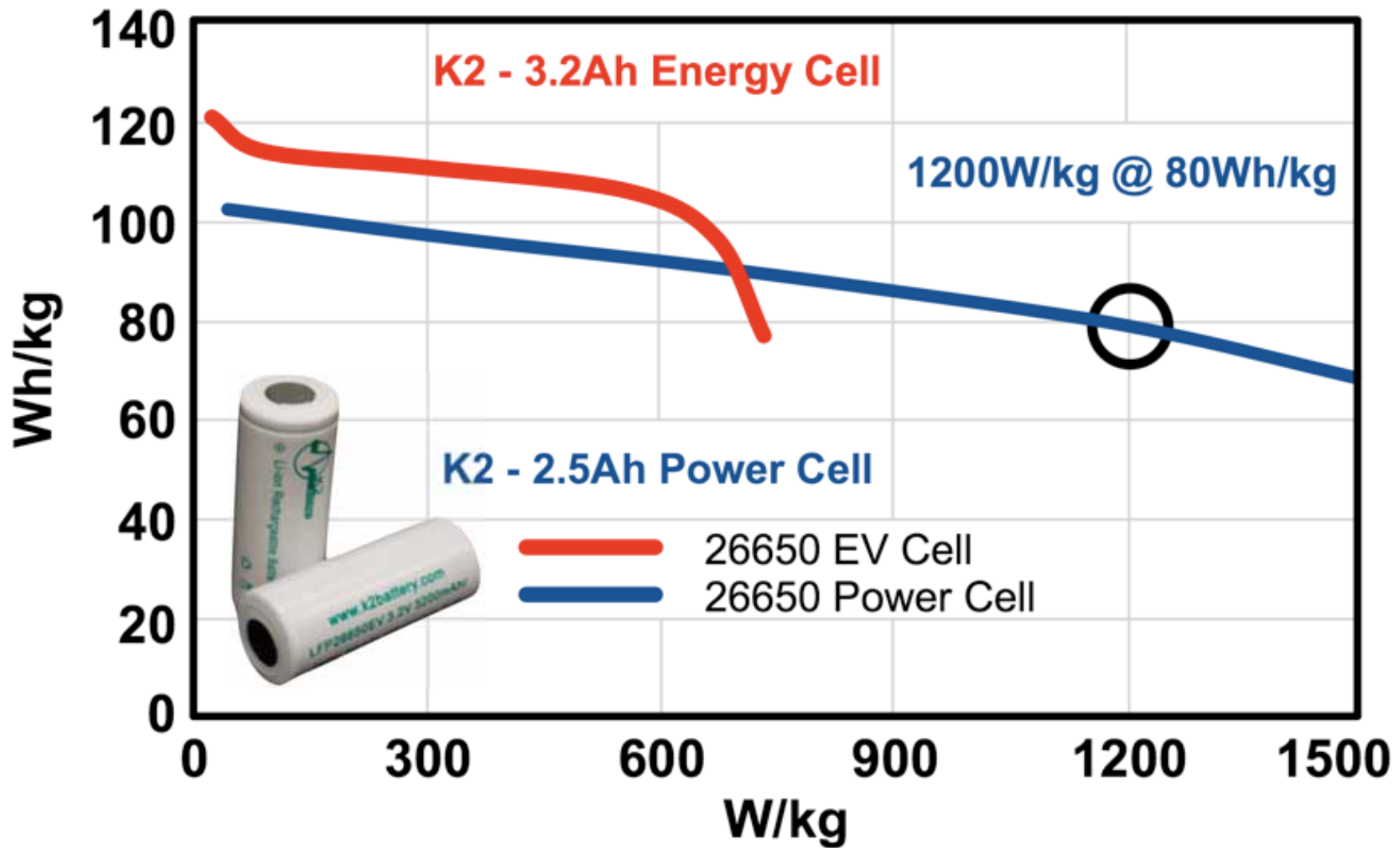
7 kWh pack

“This is a company that is seriously committed to making HEV, PHEV and EV an affordable reality for the consumer”
Prof. Andrew Frank, UC Davis



K2 Energy Solutions, Inc.

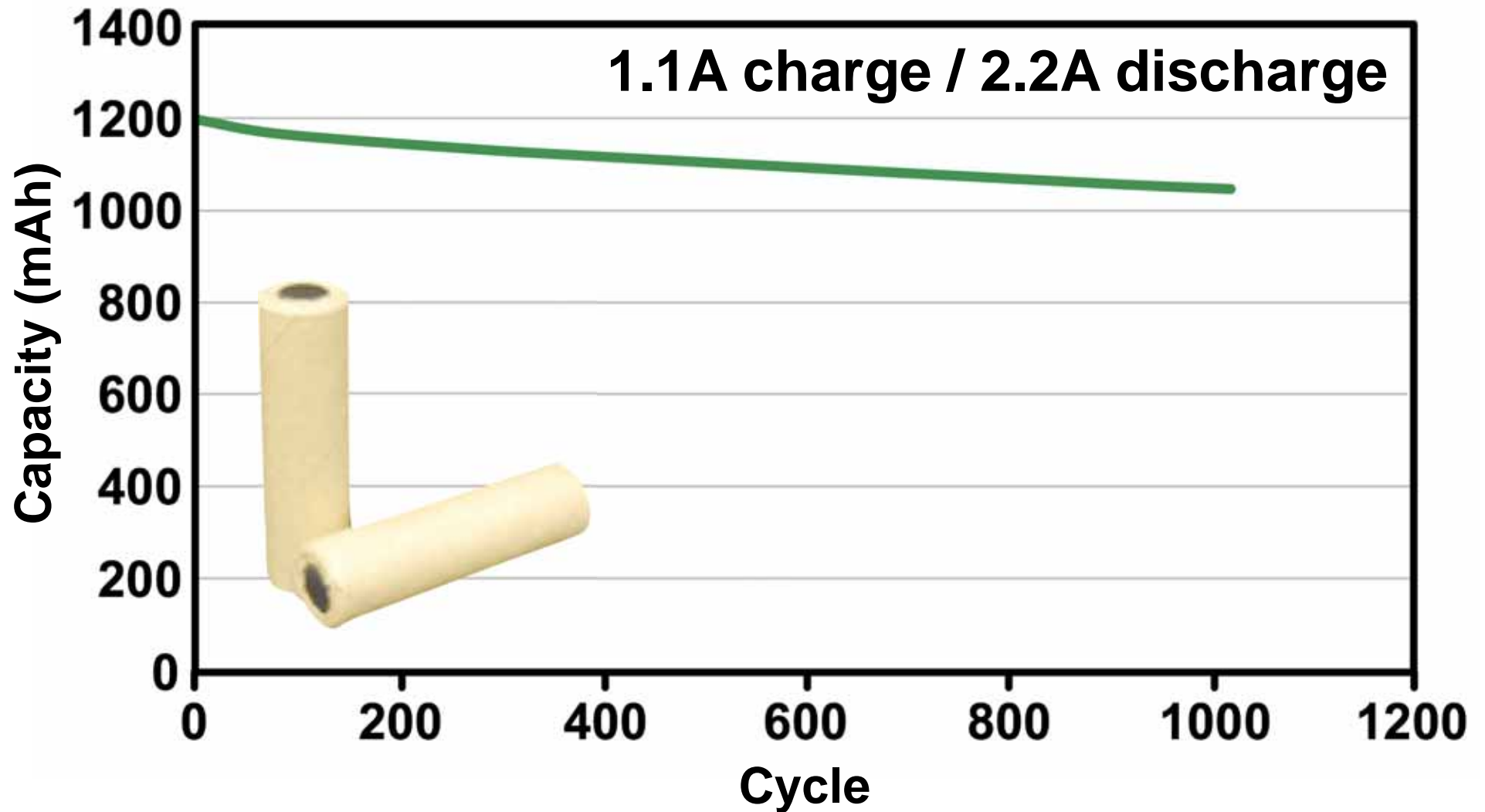
Ragone plot of 26650 cells





K2 Energy Solutions, Inc.

Life Cycle 18650 1.25 Ah Power Cell



Phostech C-LiFePO₄ is used and evaluated by numerous companies (PT, HEV, PHEV, EV, UPS...)



Others customers ★★★★★

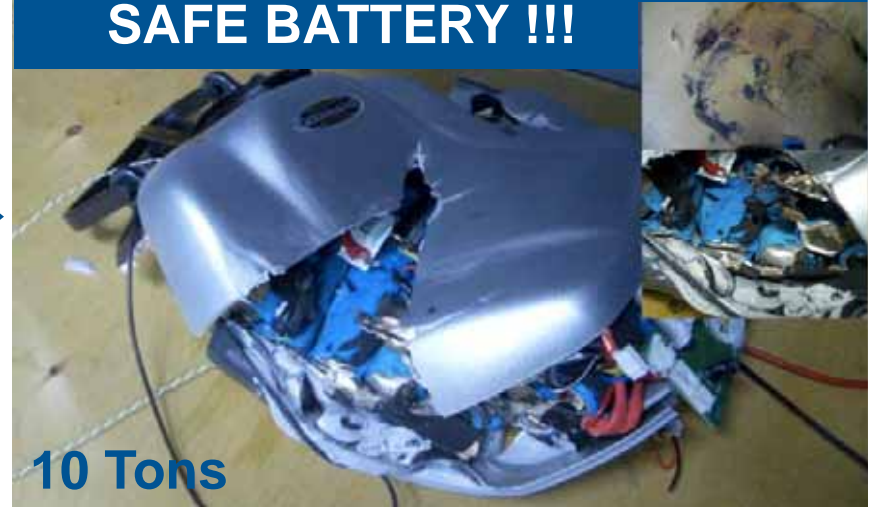
Phostech LiFePO_4 stability = safer batteries



April 2007



**NO FIRE - NO EXPLOSION
SAFE BATTERY !!!**



Battery test performs by ITRI & ExtraEnergy on **PHET[®]** battery pack

Safety level A (intrinsic pack safety)

Superb { Temperature performance
Over-voltage behavior
Over-charge behavior

**VL25Fe cells abuse testing:
(\approx 1 kg cell)**

**No fire with slow nail
No fire with overcharge**



Conclusion

- Under several controlled licences/patents/applications, Phostech produces and sells C-LiFePO₄ (Power and Energy grades) to battery manufacturers.
- When properly used in rigorous conditions, e.g. low-water content, C-LiFePO₄ leads to excellent energy, power, and cyclability performances.
- Phostech's product are used in many commercial products and applications and are being validated/in qualification worldwide by most lithium battery manufacturers.
- Material intrinsic stability leads to safer cells, important for application using large lithium-ion batteries (PHEV, EV, UPS, Storage, Grid Stabilisation,...).
- Phostech develops new C-LiFePO₄ grades and collaborates with customers to design products and specifications best adapted to their applications.

Contact

Thorsten Lahrs
Chef de la direction / CEO

1475, rue Marie-Victorin
Saint-Bruno QC Canada J3V 6B7
tél. / phone: 450 653-1810 (222)
fax: 450 653-4203
Cell.: 514 813-0883
tlahrs@phostechlithium.com

Michel Parent

Spécialiste d'application / Application Specialist
mparent@phostechlithium.com

1475, rue Marie-Victorin
Saint-Bruno QC Canada J3V 6B7
tél. / phone : 450 653-1810 (246)
fax : 450 653-4203