IPRO – 362

Design & Testing of a Lithium-Ion Battery for Electric/Hybrid Vehicle Applications

Sponsors: IIT, All Cell Technologies & JBRO Batteries

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COMPARISON

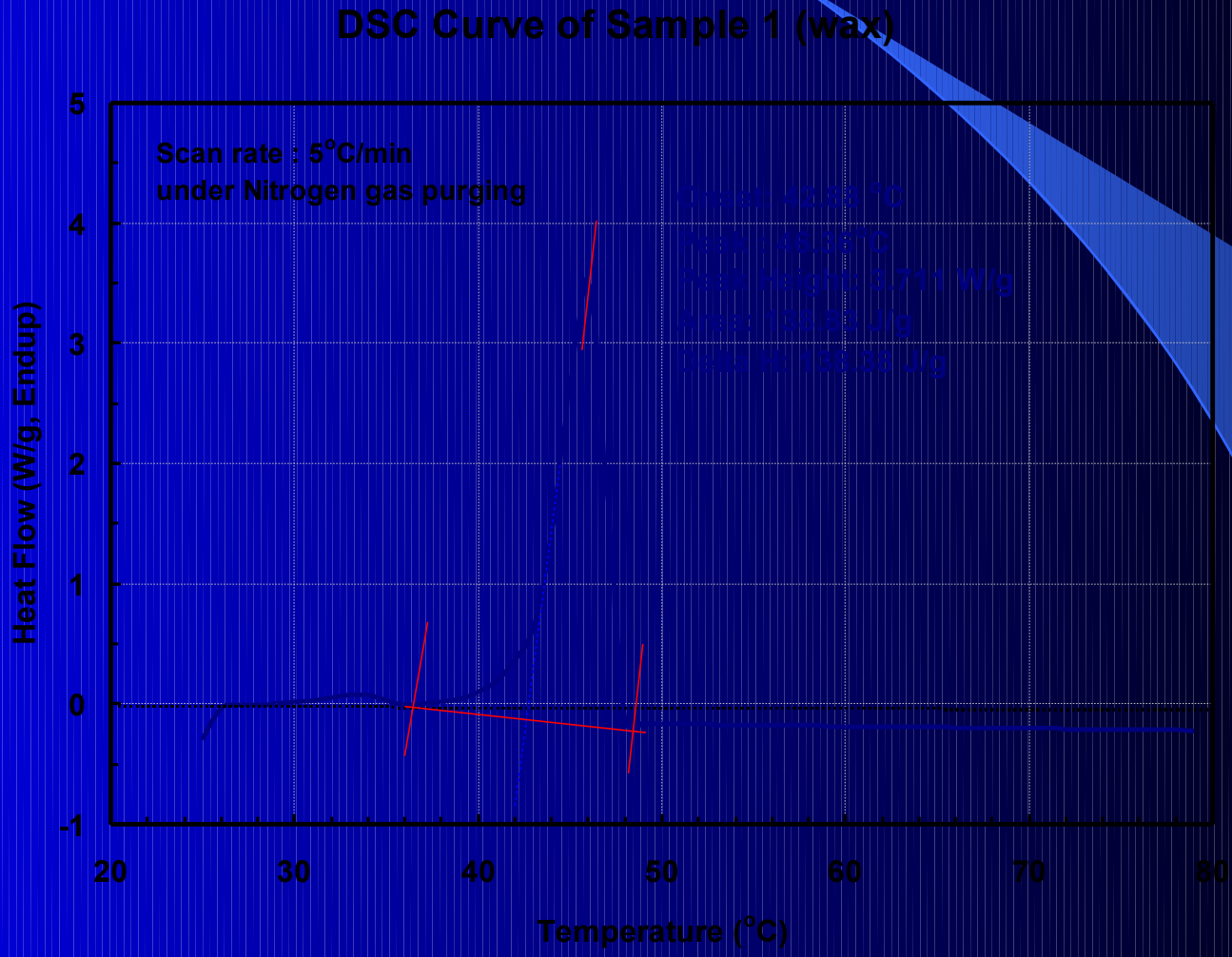
	Lead Acid	Li-Ion
Gravimetric Energy Density(Wh/kg)	30-50	110-160
Cycle Life	200-300	500-1000
Fast Charge Time	8-16 hours	2-4 hours
Cell Voltage	2V	3.6V
Maintenance Reqd/	3-6 months	Not Reqd.
Cost per Cycle($)	0.10	0.14

Selection of appropriate PCM

- Criteria:
  - Melting point at practical range of operation
  - High latent heat & heat of fusion
  - Thermal conductivity
  - Minimum super cooling
  - Non toxic & non corrosive

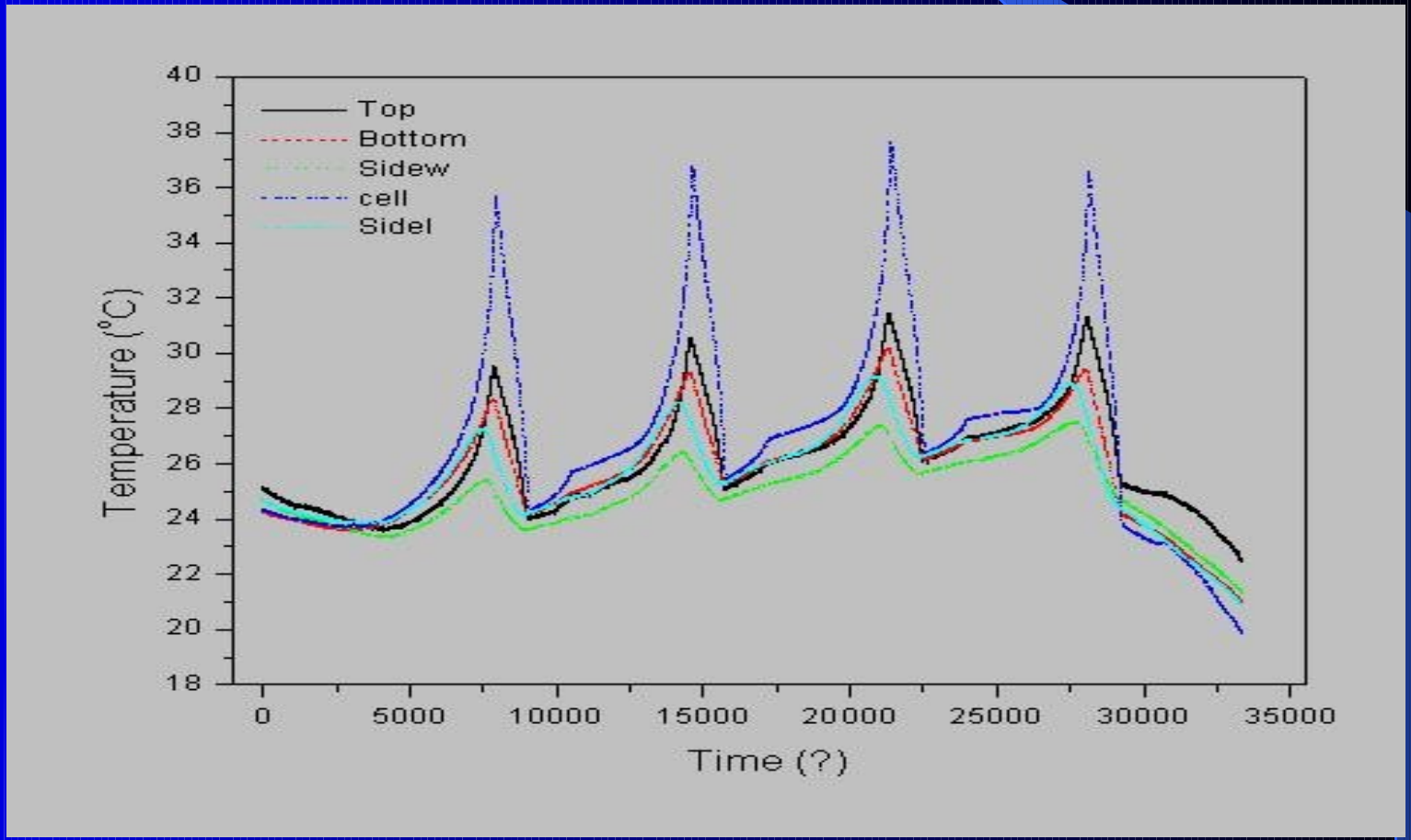
Testing of PCM

Material: Paraffin wax Melting range: 42 °C -46 °C



Bench Scale Experiment

- To determine thermal behavior of Li-ion battery
- Tested 2 Li-ion cells with paraffin wax as PCM in a plexi-glass chamber



Advantages of the Li-Ion Battery

- Considerably lighter than Lead Acid Batteries
- Longer operating life
- Environment Friendly
- Maintenance Free

Electric Scooters

- Fun to ride
- No noise or air pollution
- Allowed on public conveyances

Electric Bikes

- Allow for extended trips
- Useful for senior citizens
- In use by police & security squads
- By 2005, sales are predicted to be 6.6 million units (0.4% of total bike market)!!!

Why change??

- Increased speeds
- Increased range
- Lower weight
- Faster charging time
- Longer Life

A Novel Application

- IT scooter from Dean Kamen
- 65-80 pounds
- 12 mph
- Six hours of travel for a dime
- Concerns - weight and price

Hybrid Cars

- Fuel cost savings (50-75%)
- No dependence on foreign oil
- Lesser pollution
- Reduced Maintenance costs
- Less vibration and fatigue
- 30-50% consumers would pay upto 25% more for this benefits

Hybrid Cars:Li-Ion vs NiMH

	NiMH Battery of Toyota Prius	Li-Ion Battery (estimated)
Cells	D Size	18650
Weight of cells	140 gms	42 gms
Nominal Voltage	1.2 V	3.6 V
1 Hr Charge Current	4.5 A	1.8 A
Cost per cell	~ $ 5	~ $ 3
Cost in kWh	~ $ 694	~ $ 460

Wheelchairs

- Wheelchairs weigh in at about 200 pounds
- Add 50-100 pounds for the batteries
- Battery is 25-30 % of total weight
- Lead Acid Wheelchairs not allowed on most airlines
- Recharge time 12-24 hours
- Maintenance requirements

Wheelchairs & Li-ion

- Drastically reduces weight (Li-Ion-9 lbs, U1-50 lbs, NF22-100 lbs)
- Increased operating range (25 vs 15 miles)
- No maintenance requirements
- Costs may be eligible for Medicare reimbursements

Lawn Mowers

- Replacing gas with electric reduces harmful emissions by 99%
- Noise pollution is vastly reduced (90dB to 70dB)
- Cordless Electrics use $3-4 of electricity per year
- No tune ups
- Using Li-Ion, weight is reduced by 25 lbs
- Charging time reduced from 24 to 5 hours

Other Applications

- Neighbourhood Electric Vehicles
- One Person Cars
- Electric Pedicabs
- Electric Go-Karts
- Golf Carts

Intellectual Property Issues

- Patents
- Trademarks
- Trade Secrets

Conclusion

- Essentially,with a lower weight, improved performance plus maintenance free & environment friendly characteristics make Li-Ion a viable alternative to Lead Acid Batteries.

Thank You