



Cutting through the battery fog

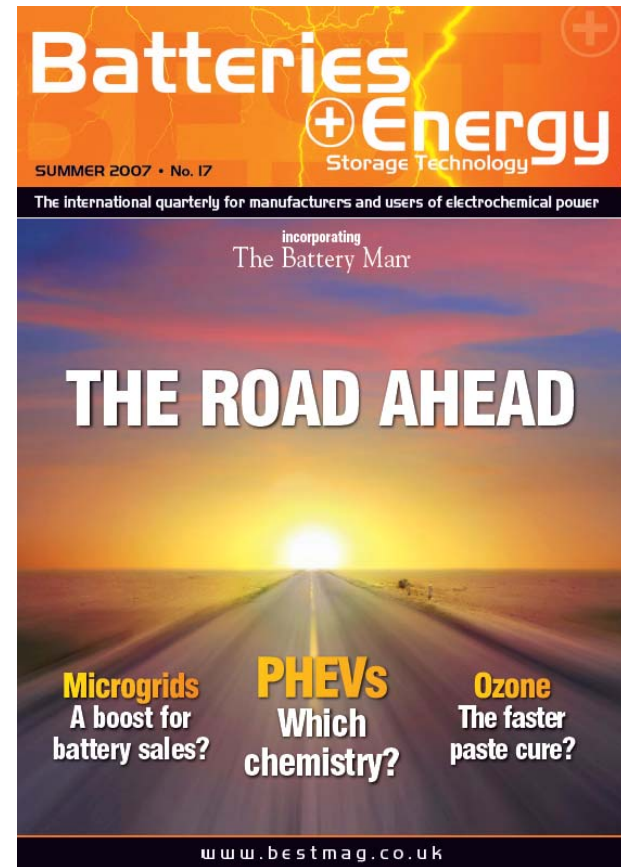
What's really going on in hybrid
electric vehicle design

A personal view from the Editor of BEST
magazine

September 17th 2007



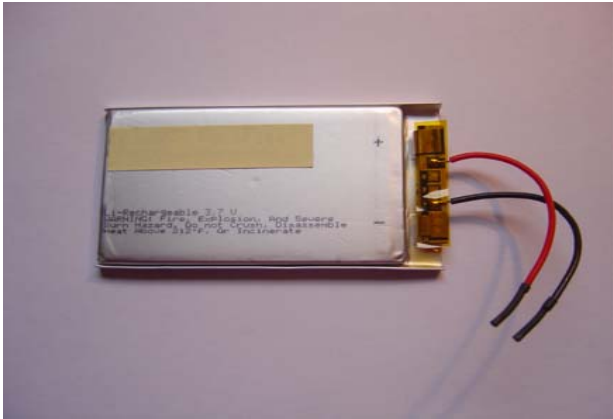
- Launched 2003
- 6000 readers in 90 countries
- Recognised as Best source of intelligence on all battery manufacture and applications



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- Green vehicles are vehicles with a greater component of electric traction
- Electric traction enables energy capture through regenerative braking
- Regenerative braking demands electric energy storage
- This is best provided through the use of...

Batteries.. What else?





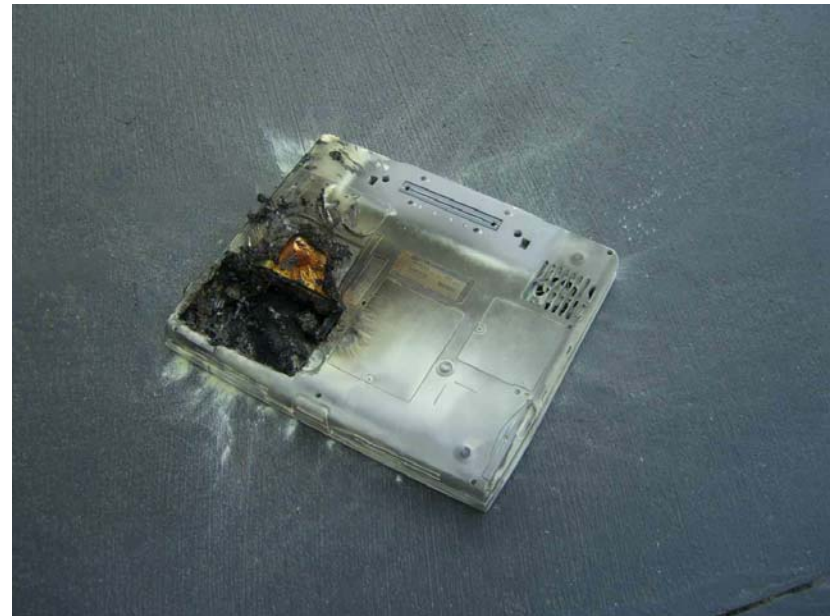
which chemistry?

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- The big issues: energy density & cost

System	Lead/Acid	Ni/MH	Li-ion
Wh/kg	30-40	40-60	60-80
W/kg	600-800	1000-1200	2000-3000
\$/kWh	150	800-1000	600-1200

- Best energy density isn't always safest
- Lap top experience has cautioned automakers
- Lithium still a good bet



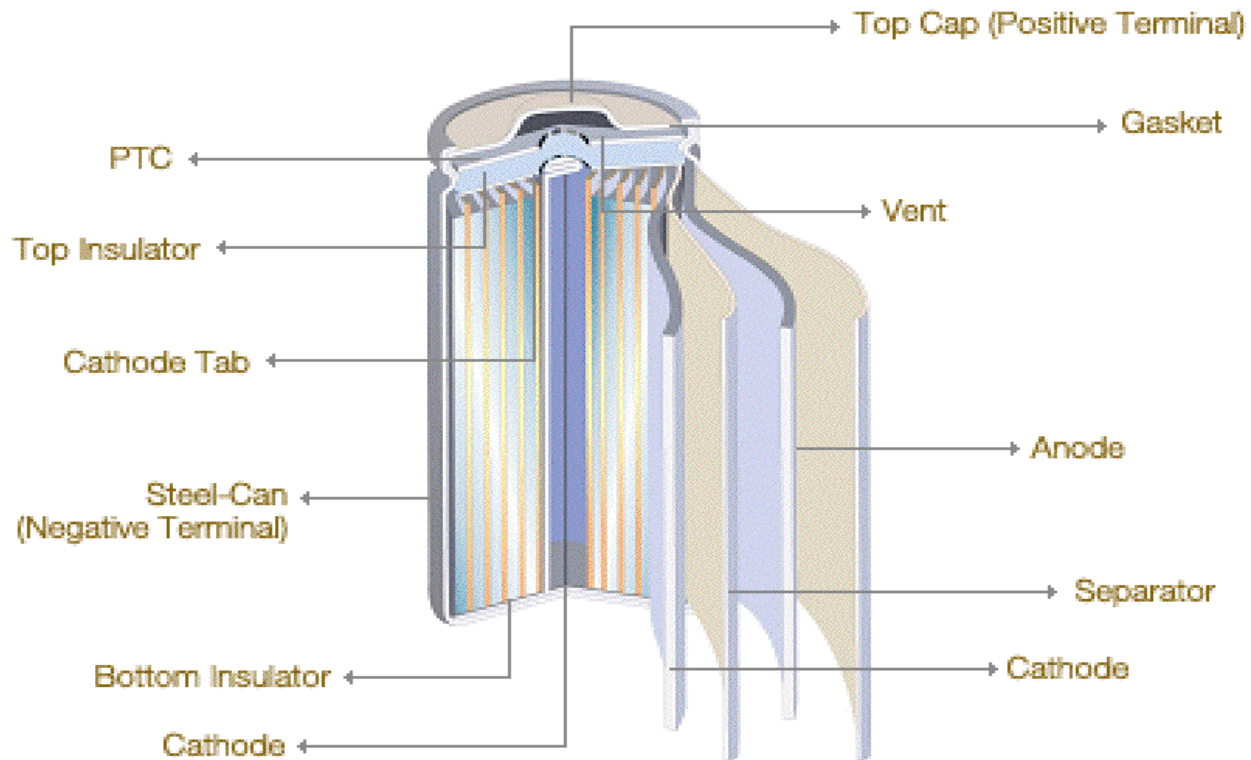
- No one will risk going from this



To this!

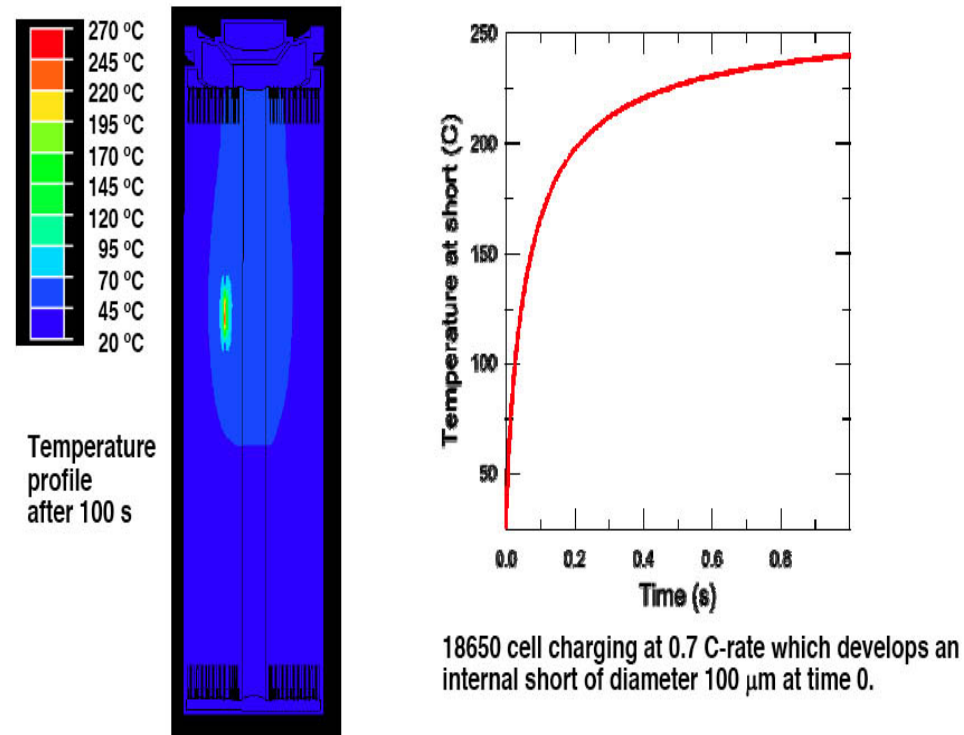


Inside a lithium ion cell



- The problem:
micro-shorts
- Causes massive rise
In temperature+600°C
- Hard to detect
impossible to arrest

Simulated Temperature Rise Caused by Internal Short





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- Can it be overcome?
- Yes, cells with thicker separators, more electronics,
- Enhanced failure prediction



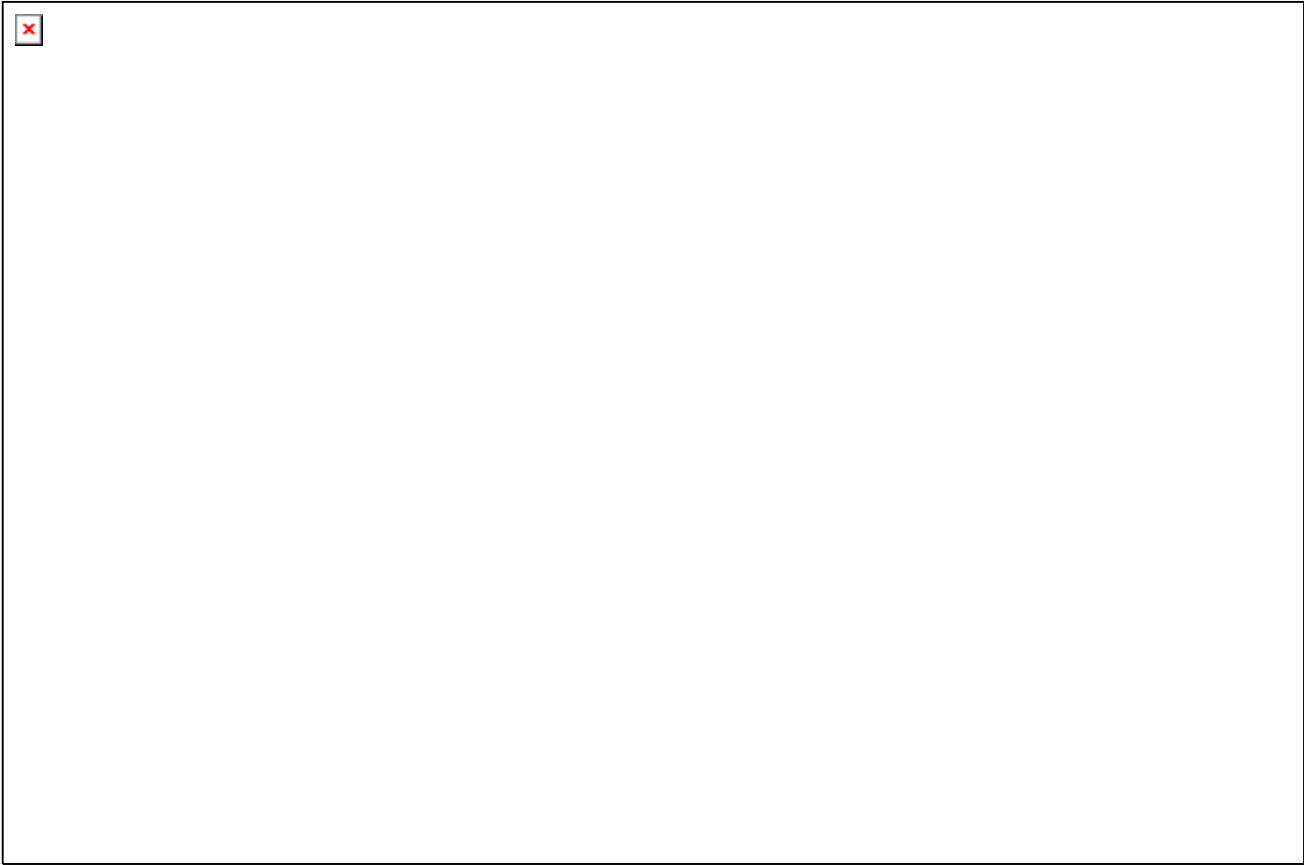
Where we are at: NiMH

- Safe and reliable— used in Prius and virtually all hybrid vehicles.
- Long lasting (in partial state of charge mode)
- Cost□ly. Price of Nickel has increased markedly

Alternative technologies

- Ultrabattery
- combines lead-acid and super capacitor
- No electronics for cell balancing
- very high cyclability
- Applicable to mild hybrid designs





Where we're at....hybrid electric cars .

- High power lithium ion is delayed for cars
- Nickel metal hydride remains chemistry of choice but for how long?
- Lead-acid, a rank outsider makes inroads in micro hybrid market (BMW)

The challenge of the Plug in hybrid

Confusing messages from car
makers

What is a plug-in hybrid vehicle?

It is a vehicle which uses is battery initially(charge depleting mode) and then using an IC engine to charge the battery and provide motive power. It is possible to run the vehicle for short journeys entirely on mains-derived electricity



Base vehicle

- 4-cylinder gasoline (105 kW/210 Nm)
- Weight 1960 kg

E-Motor

- Power (peak) 70 kW (90 kW)

Battery

- Capacity 14 kWh NiMH / 15 kWh Li-Ion
- Weight 300 kg NiMH / 160 kg Li-Ion

Fuel /CO2 reduction

- 10 % to 50 % according to operation



- Exceptional fuel economy maybe 100mpg

- huge emission reduction

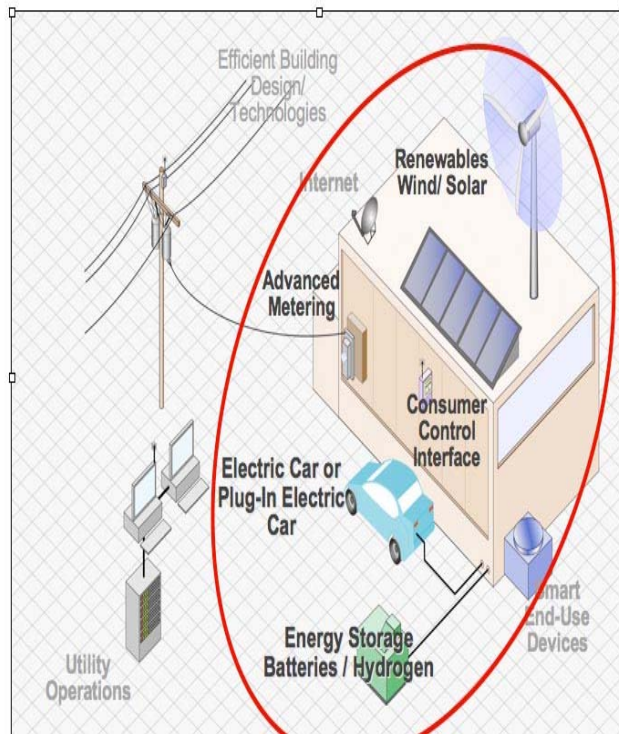
- * some all electric range

Is possible (20miles+)

- Huge challenge to battery design (battery will be deeply discharged)
- Significant cost increase.
- Significant intrusion into load space (body redesign?)

- Mixed messages from auto industry
- Toyota both embraces and abhors PHEVs in press statements
- (reason: uncertainty over battery design issues)

Home of the Future Vision



- Utility backing for PHEVs
- Ford and others working with Southern California Edison
- Win win scenario with distributed energy storage/ reduced oil consumption

To conclude

- Electrical energy storage underpins hybrid and PHEV development
- It also underpins integration of some renewable energy generation
- It's a great time to be in batteries—whatever the chemistry!



Thank you !

More information: www.bestmag.co.uk

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