BATTERY POWER

Solutions for OEM Design Engineers, Integrators & Specifiers of Power Management Products

Formerly Titled
Battery Power Products & Technology

From Batteries to Ultracapacitors:

How Advancing Technologies are Impacting Electric Vehicles

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Flat top cells for assembly

SUB-C SIZE

	Cell Size	Capacity mAh	Size (inches) Dia	Hgt	Dantona PT#
NICD	1/2SC	700	0.906	1.02	1/2SC-700
	4/5SC	1300	0.906	1.34	4/5SC-1300 **
					4/5SC-1300CS **
	SC	1500	0.906	1.69	SC-1500 **
					SC-1500CS **
		1900	0.906	1.69	SC-1900 **
		2100	0.906	1.69	SC-2100 **
					SC-2100CS **
		2400	0.906	1.69	SC-2400CS **
	5/4SC	2300	0.906	1.97	5/4SC-2300
** Rapid Charge / High Rate Discharge for Power Tool					
NIMH	4/5SC	2000	0.906	1.34	4/5SCR-2000NIM **
					4/5SCR-2000NIM-CS **
	SC	3300	0.906	1.69	SCR-3300NIM **
					SCR-3300NIM-CS **

Gold Peak is mfg of cells with "GP" in PT#

AF SIZE

	Cell Size	Capacity mAh	Size (inches) Dia	Hgt	Dantona PT#
NICD	1/3AF	250	0.67	0.67	1/3AF-250
	2/3AF	700	0.67	1.1	2/3AF-700
	4/5AF	1400	0.67	1.69	4/5AF-1400
	AF	1500	0.67	1.97	AF-1500
	5/4AF	2000	0.67	2.63	5/4AF-2000-GP
Dantona stocks the most complete line of single cells in the country !!					
NIMH	1/3AF	600	0.67	0.67	1/3AF-600NIM
	2/3AF	1100	0.67	1.1	2/3AF-1100NIM-GP
	4/5AF	2100	0.67	1.69	4/5AF-2100NIM-GP
		These cells replace Sanyo: HR-4/5AU			
	AF	2000	0.67	1.69	4/5AF-2000
		2500	0.67	1.97	AF-2500NIM-GP
		These cells replace Sanyo: HR-AU			
		2700	0.67	1.97	AF-2700NIM
	4/3A (17MM)	3800	0.67(17mm)	2.63	4/3AF-3800NIM-GP
		These cells replace Sanyo: HR-4/3AU			
			0.67(17mm)	2.63	4/3AF-3800NIM
	4/3A (18MM)	4500	.71 (18mm)	2.63	4/3AF-4500NIM-GP
		These cells replace Sanyo: HR-4/3FAUX			
			.71 (18mm)	2.63	4/3AF-4500NIM

Unless otherwise indicated, all capacity is based on standard charge / discharge rates for all cells
"CS" on end of Part Number means cell comes in cardboard sleeve, not shrink wrap.

Flat top cells for assembly

AA SIZE

	Cell Size	Capacity mAh	Size (inches) Dia	Hgt	Dantona PT#
NICD	1/3AA	150	0.57	0.67	1/3AA-150
	1/2AA	250	0.56	0.94	1/2AA-250SHORT
	2/3AA	400	0.57	1.18	1/2AA-400
	AA	600	0.55	1.97	AA-600FT
	AA	800	0.55	1.97	AA-800FT
	AA	1000	0.55	1.97	AA-1000FT
Dantona stocks the most complete line of single cells in the country !!					
NIMH	1/3AA	300	0.57	0.67	1/3AA-300NIMFT
	1/2AA	500	0.56	0.94	1/2AA-500NIM-SHORT
	2/3AA	750	0.57	1.18	1/2AA-750NIM-GP
	4/5AA	1200	0.57	1.65	4/5AA-1200NIM
	AA	1600	0.55	1.97	AA-1600NIMFT
	AA	1800	0.55	1.97	AA-1800NIMFT
	AA	2100	0.55	1.97	AA-2100NIMFT
	5/4AA	2200	0.55	2.64	5/4AA-2200NIMFT

Need a large quantity of cells, Lets get you a better price !!

Flat top cells for assembly

Gold Peak is mfg of cells with "GP" in PT#

AAA SIZE

	Cell Size	Capacity mAh	Size (inches) Dia	Hgt	Dantona PT#
NICD	AAA	300	0.414	1.75	AAA-300FT
Gold Peak is the manfacturer of cells with "GP" in the part number.					
NIMH	1/4AAA	110	0.41	0.43	1/4AAA-110NIM-GP
	1/3AAA	170	0.41	0.56	1/3AAA-170NIM-GP
	1/2AAA	350	0.41	0.9	1/2AAA-350NIM-GP
	2/3AAA	400	0.41	1.15	2/3AAA-400NIM
	4/5AAA	500	0.41	1.43	4/5AAA-500NIM-GP
	AAA	750	0.41	1.72	AAA-750NIMFT
	AAA	950	0.41	1.72	AAA-950NIMFT
	5/4AAA	800	0.41	1.96	5/4AAA-800NIM

AAAA (QUAD A)

	Cell Size	Capacity mAh	Size (inches) Dia	Hgt	Dantona PT#
NIMH	1/3AAAA	100	0.34	0.60	1/3AAAA-100NIM-GP
	1/2AAAA	180	0.34	0.82	1/2AAAA-180NIM-GP
	2/3AAAA	200	0.34	1.15	2/3AAAA-200NIM-GP
	AAAA	300	0.34	1.6	AAAA-300NIM-GP
	5/4AAAA	500	0.34	2.05	5/4AAAA-500NIM-GP

Flat top cells for assembly

PRISMATIC CELLS

	Cell Size	Capacity mAh	Size (mm) Length / Width / Thick	Dantona PT#
NIMH	PRISMATIC	1200	67 x 17 x 6.1	HF-A1U
	PRISMATIC	800	48 x 17 x 6.1	HF-B1UX
	PRISMATIC	600	37.5 x 17 x 6.1	HF-C1U
	PRISMATIC	500	34 x 16 x 6.3	HF-D4U

NOTE: Some cells are slightly different in size from Sanyo original cells. Please be sure to request samples to assure size before assembling into packs where size is an issue.

Flat top cells for assembly

C SIZE

	Cell Size	Capacity mAh	Size (inches) Dia	Hgt	Dantona PT#
NICD	1/2C	700	1.02	0.946	1/2C-700FT
	3/5C-1100	1100	1.02	1.18	3/5C-1100
	C	2500	1.02	1.97	C-2500FT
	C	3000	1.02	1.97	C-3000FT
Don't see an item, Call Dantona, we probably have it.					
NIMH	C	4500	1.02	1.97	C-4500NIM

D SIZE

	Cell Size	Capacity mAh	Size (inches) Dia	Hgt	Dantona PT#
NICD	1/2D	2400	1.34	1.5	1/2D-2400
	D	5000	1.34	2.4	D-5000FT
When you think batteries, think DANTONA !!					
NIMH	1/2D	5000	1.34	1.5	1/2D-5000NIMFT
	D	9000	1.34	2.4	D-9000NIM

F SIZE

	Cell Size	Capacity mAh	Size (inches) Dia	Hgt	Dantona PT#
NICD	4/3D (F)	7000	1.34	3.6	F-7000
We know the quality of these cells, we make 100's of thousands of packs using them !!					
NIMH	4/3D (F)	13000	1.34	3.6	F-13000NIM

BUTTON CELLS

	Cell Size	Capacity mAh	Size (inches) Dia	Hgt	Dantona PT#
NICD	30	30	0.46	0.21	30SS
	60	60	0.61	0.23	60SS
	200	200	0.98	0.33	200SS
Dantona stocks more single cells than anyone in the country.					
NIMH	40	40	0.46	0.21	40SSNM
	80	80	0.61	0.23	80SSNM
	250	250	0.99	0.25	250SSNMH
	320	320	0.99	0.33	320SSNM

CUSTOM MADE PACKS

Did you know that Dantona assembles custom packs in all shapes, sizes and configurations. Contact us for details.

Consumer use cells

Consumer cells perform the same as "Flat Top Cells" however they have a raised top that allows them to make contact in consumer devices and chargers.

AA SIZE

	Cell Size	Capacity mAh	Size (inches) Dia	Hgt	Dantona Part No.
NICD	AA	600	0.55	1.97	AA-600
	AA	800	0.55	1.97	AA-800
	AA	1000	0.55	1.97	AA-1000
Call 1-800-DANTONA (1-800-326-8662) FOR SAME DAY DELIVERY					
NIMH	AA	1600	0.55	1.97	AA-1600NIM
	AA	1800	0.55	1.97	AA-1800NIM
	AA	2100	0.55	1.97	AA-2100NIM
	AA	2500	0.55	1.97	AA-2500NIM

AAA SIZE

NICD	AAA	350	0.414	1.75	AAA-350
When you think batteries, think DANTONA !					
NIMH	AAA	750	0.414	1.75	AAA-750NIM
	AAA	900	0.414	1.75	AAA-900NIM

C SIZE

NICD	C	2000	1.02	1.97	C-2000
	C	2500	1.02	1.97	C-2500
	C	3000	1.02	1.97	C-3000
Don't see an item, Call Dantona, We probably have it.					
NIMH	C	4500	1.02	1.97	C-4500NIM

D SIZE

NICD	D	4000	1.34	2.4	D-4000
	D	5000	1.34	2.4	D-5000
When you think batteries, think DANTONA !					
NIMH	D	9000	1.34	2.4	D-9000NIM

9V SIZE

NICD	9V	120	STANDARD 9V SIZE	9V-8.4NICD
Gold Peak is the manfacturer of packs with "GP" in the part number.				
NIMH	9V (9.6V)	170	STANDARD 9V SIZE	9V-9.6NIMH-GP
	9V (8.4V)	200	STANDARD 9V SIZE	9V-8.4NIM-GP
	9V (8.4V)	280	STANDARD 9V SIZE	9V-8.4NIM-280

Dantona also stocks a full line of Sanyo and Panasonic Nicad and Nimh batteries.

Available cells and capacities may change without notice.

Call 1-800-Dantona (800-326-8662) for SAME DAY DELIVERY

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BATTERY POWER
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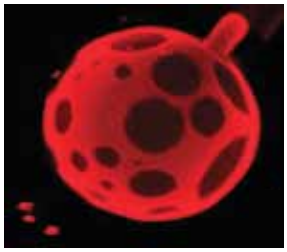
Editor's Choice



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Editor's Choice

Welcome to the inaugural redesigned, renamed issue of *Battery Power* magazine (formerly *Battery Power Products & Technology*). After 14 years serving the battery industry, we decided to give the magazine a face lift. Most noticeable is the size of the magazine. The new standard format will provide more file-friendly storage, keeping *Battery Power* on hand for easy reference.

Editor's Choice is a new section that will highlight some of the most innovative and interesting industry breakthroughs. We will still showcase the latest products entering the marketing as well as industry news items.

We hope you enjoy the new *Battery Power* magazine and as always, we welcome your thoughts and feedback.

Shannon Given, *Director of Content*
Shannong@infowebcom.com

Dana Develops Industry-First Battery Cooling Technology for Electric Vehicles

Dana Holding Corp. has developed a long heat exchanger designed to extend battery life in hybrid and electric vehicles. Lithium-ion battery life is dependent on maintaining optimum operating temperature. Dana's heat-exchange technology cools the Roadster's battery by transferring heat generated within the battery to the vehicle's climate-control system. In addition, a temperature sensor mount provides continuous feedback to the climate-control system. This interface helps to maintain the battery's ideal temperature during operation, thus helping to extend battery life.

Dana engineers constructed the heat exchanger using a patented aluminum brazing process, ensuring cleanliness of both the climate control and battery coolant fluids. The use of high-strength aluminum alloys provides greater material strength and contributes to weight savings. Additionally, the chiller's compact design also provides space savings, critical for helping engineers accommodate the Roadster's 6,800-cell battery pack.

Saft Develops Super-Phosphate Technology for Rigorous Defense Applications

Saft has expanded its range of lithium technologies with the VL 10V Fe Super-Phosphate. Saft designed and developed the VL 10V Fe Super-Phosphate cell capable of producing continuous power of 7 kW/kg. These large cells are designed for defense applications, such as US Navy undersea operations, requiring very high power and safe operation.

"Saft's advanced lithium iron phosphate technology fills a void in the market for high power lithium batteries for use in applications with low abuse tolerance," said Thomas Alcide, Saft Specialty Battery Group general manager.

Compared with standard lithium iron phosphate cells, Saft's Super-Phosphate cell, in addition to its ability to accept very high regenerative charge rates, features proven safety, longer cycle life, better calendar life and a wide operating temperature range including

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improved lower temperature performance.

Saft uses a licensed form of iron phosphate developed by scientists at the University of Texas and the cells are being manufactured in the US.

Total Signs a Research Agreement with MIT

Total announces the signing of a research agreement with the Massachusetts Institute of Technology (MIT) to develop new stationary batteries that are designed to enable the storage of solar power. This agreement valued at $4 million over five years and is part of the MIT Energy Initiative, which Total joined as a member in November 2008.

The Total-MIT research project is primarily focused on development of a low-cost, long-life battery suited to store the power generated by solar panels. The ability to store power is a major challenge and an essential ingredient for the scale up and widespread deployment of affordable solar power.

Flux Power Introduces Safe Lithium Battery and Charging Systems for Industrial, Solar, EV, Wind and Peak-Shaving Power Applications

Flux Power, Inc. has introduced its new safe lithium batteries as well as its new 12 V to 450 V ruggedized and environmentally protected AC-DC charger. These high power products are meant to serve as backbone technology for the EV, solar, wind, industrial and peak-shaving industries.

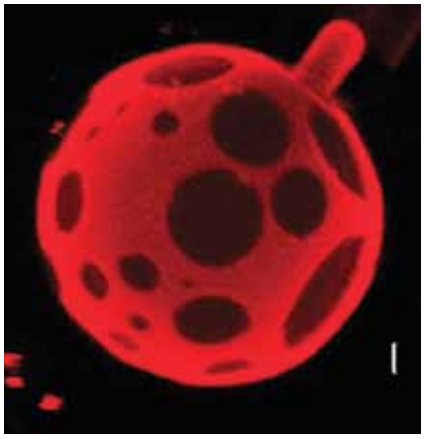
Flux Power's LiFePO4 family of products offer improved energy density, discharge ability, communications, redundant safety and life cycle tracking at an affordable price. Each 12 V pack comes with an integrated battery management system featuring Flux Power's Cell Guard technology that monitors the individual cells within the battery. Voltage, temperature, charge and discharge cycles are all monitored with Cell Guard and managed to dramatically extend the life of each lithium cell in the system. This management has been shown to extend the life of Flux Powers' Lithium cells by four to five times versus an unmanaged system.

Flux Power's system also records every charge and discharge cycle that each cell sees through over its lifetime. This unique tracking enables instant identification of any cell deficiencies and allows extended warranties on the complete system. In addition, the new Flux Power 12 V to 450 V charger is a ruggedized and environmentally protected AC-DC charging solution that can be easily adapted to many applications. This charger features a dual CAN Bus Interface and can be run as a single unit in a variable output mode up to 3.3 kW or stacked to provide more than 50 kW of charging power.

Penn Team Uses Self-Assembly to Make Tiny Particles With Patches of Charge

Physicists, chemists and engineers at the University of Pennsylvania have demonstrated a novel method for the controlled formation of patchy particles, using charged, self-assembling molecules that may one day serve as drug-delivery vehicles to combat disease and perhaps be used in small batteries that store and release charge.

Researchers have demonstrated that the positive electrical charges of calcium ions, just like the calcium in teeth and bone, can form bridges between negatively charged polymers that would normally repel each other. The polymers, similar to the lipids that make the membranes surrounding living cells, have both a water-loving part linked to a water-repelling part. On the surfaces of these cell-sized polymer sacks, the calcium ions create calcium-rich islands or patches on top of negatively-charged polymer. Copper ions also work, and the patches can be made to coalesce and cover half of the particle. This polarized structure is the basic arrangement needed to set up, for example, the two electrodes of a microscopic battery. They could also one day be functionalized into docking sites to enhance targeted delivery of drug-laden particles to cells.



Confocal microscopy images of spotted polymerosomes. Scale bars: 2 μm

While the concept seems simple, that opposite charges attract, the creation and control of patches on one small particle has been a challenge. Scientists like Dennis Discher, principal investigator of the study and a professor of chemical and biomolecular engineering at Penn, are designing materials at the nanoscale because future technologies will increasingly rely on structures with distinct and controlled surfaces. Physicians, for example, will improve medical therapies by wrapping drugs within the bioengineered polymer sacks, or by creating tiny biomedical sensors. Green energy production and storage will also require structures with scales no longer measured by inches, but by micrometers and nanometers.

SAE International Forms Committee to Create Vehicle Battery Standards

The continued development of new and advanced battery technologies will play a critical role as vehicle manufacturers increase the availability of hybrid-electric vehicles, move toward the implementation of plug-in hybrid-electric and battery-exclusive vehicles, and continue research into other variations of electric-related vehicle propulsion systems. To address this growing technology and to help standardize development, SAE International is creating a new Vehicle Battery Standards Committee that will serve as a center for standardization.

The new SAE Vehicle Battery Standards Committee will initially focus on standardizing battery performance and safety and will assure harmonization with other standards development in the US and around the world.

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Money Saving Advancements in Battery and Charging Technology

Steve Spaar, Director of Marketing
EnerSys

After years of scant innovation, recent advancements in battery charging technology offer new options for industrial fleet truck managers. These power options include energy efficient high frequency charging, opportunity/fast charging and fuel cells, just to name a few. Vendors competing in these markets emphasize the benefits of these charging alternatives but rarely mention their potential shortcomings. To make an educated purchasing decision, you should be aware of the strengths and the weaknesses of your battery charging choices.

High Frequency Chargers

Traditionally, forklift battery chargers have been based on either ferroresonant (Ferro) or silicone controlled rectifier (SCR) technology. High frequency (HF) chargers using either metal oxide semiconductor field effect transistor (MOSFET) or insulated gate bipolar transistor (IGBT) switching components have been the dominant European charger technology for the past 15 years. HF chargers are gaining in popularity in North America with the growth of the "green" environmental movement.

HF chargers can reduce electric costs by 10 percent or more when compared with SCR and Ferro chargers. This level of savings typically ensures a two to three year payback on the HF price premium. With the expected rise in electricity costs over the next five years, this payback period will likely shorten. HF chargers also have comparatively lower AC circuit sizing requirements that can significantly reduce electrical infrastructure costs. Also, many electric utilities offer rebates to companies that reduce their utility system demands. HF chargers are the right fit in this regard because of their greater efficiency and higher power factor compared to SCR and Ferro technologies.

So what's the downside? Currently, HF chargers command a higher price than their SCR and Ferro counterparts. But the rising costs of copper and laminated steel used in Ferro and SCR chargers, coupled with electric utility rebates, are eliminating these price differences.

Opportunity and Fast Charging

Many of the chargers sold today for standard rate opportunity charging and high rate opportunity charging (fast charging) employ the efficient HF technology described above. In these cases, however, the overriding value proposition is not electrical efficiency savings. Opportunity and fast charging value is found in the time, labor and equipment savings resulting from eliminating the need to change out fully discharged batteries.

The concept is to recharge batteries at every "opportunity" during the day including breaks, lunch and shift changes. By keeping the battery in a constant partial state of charge throughout the day, batteries no longer need to be changed out. This practice is quite different from the customary fleet management operation that includes fully discharging a battery, removing it from the truck, placing the battery on charge and replacing it with a freshly charged battery.

The difference between opportunity and fast charging is the charge rate applied to the battery. The charge rate selected will depend upon the amount of energy that needs to be replaced during charging opportunities. The goal is to ensure enough battery capacity to keep the lift truck running throughout the shift-day without changing batteries.

Opportunity and fast charging are good alternatives for companies looking to convert internal combustion lift trucks to zero-emission electric trucks. Opportunity and fast charging do not require dedicated floor space for charging, changing and storing spare batteries used in conventional battery charging operations.

But opportunity and fast charging have their limitations. Both opportunity and fast chargers require a disciplined work process to ensure that batteries get plugged in during breaks. Neither of these charging regimes will reduce the truck's lifetime battery investment because more energy is required in a shorter amount of time for an opportunity or fast charge battery.

Currently, only flooded lead-acid batteries are used for fast charging, so periodic battery watering maintenance is required. As with all battery charging, allowing for at least a 12 hour equalize charging window per week is necessary to maintain proper battery health and maximize cycle life.

Most flooded lead acid battery warranties limit daily throughput to 128 percent to 200 percent of the battery's rated capacity. This throughput limitation applies to the highest charge rate fast charge option. Obviously, a heavy three-shift application would not be practical for fast charging.

Charger purchase costs may also prove to be a barrier for some customers considering fast charging. While the price of an opportunity charger is comparable to a standard charger, the price of a fast charger will be significantly higher than a standard rate opportunity charger. This cost difference is related to the higher output requirements and sophisticated charging management firmware of fast chargers. Fast chargers also need more sophisticated battery monitoring instruments, which add to their cost.

Fuel Cells

Opportunity and fast charging eliminate battery changing but fuel cells can eliminate both battery changing and battery charging. Unlike batteries that store electrical energy, fuel cells convert a fuel (hydrogen) to electrical energy. Instead of charg-

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ing equipment, fuel cells require refilling a fuel tank similar to automobiles. Refilling a hydrogen tank takes only two to five minutes and, other than water vapor, there are no emissions from the fuel cells and they require very little maintenance.

Fuel cells, however, are not the panacea they are often made out to be. The price of fuel cells can be between four and five times that of a comparable lead acid battery and charging system. Government subsidies are available to offset some of this price premium. Fuel cells require hydrogen storage on location as well as a hydrogen dispensing infrastructure. Currently, on site hydrogen production is not cost effective even for large lift truck fleets.

Fuel cell stacks also need to be replaced every 7,500 to 10,000 hours of operation at a cost of $6,000 to $8,000. This means that in a two-shift, six-hour/shift, five-days/week operation (3,000 hours/year) the fuel cell stack would last 2.5 to 3.3 years.

Fuel cell distributors focus their value propositions on potential cost savings in terms of battery changing time savings and battery handling equipment cost and space reductions compared with standard battery operations. But we have seen that this same value proposition can be obtained with opportunity and fast charging without the much higher fuel cell and hydrogen infrastructure related costs.

Future Technologies

EnForcer HF IQ Charger

Most of the recent industrial truck battery innovations have been on the charger side of the equation. But the bulk of future research and development is focused on battery technology improvements. These advancements promise more available energy in smaller battery dimensions. Smaller battery dimensions will offer lift truck designers more power source flexibility that could lead to more lift truck design innovations. Also expected is improved charge acceptance while maintaining or improving cycle life of flooded lead acid battery designs.

Complementing the enhancements to traditional lead acid battery designs is the introduction of different battery chemistries such as Lithium Ion (Li-Ion). Currently, Li-Ion batteries are very expensive relative to lead acid battery chemistries. It is debatable whether increasing production volumes will have a positive or negative impact on the cost of Li-Ion in industrial applications. Also, the potential negative environmental impact of spent Li-Ion batteries is a concern. Lead acid battery recycling rates are more than 97 percent, which represents the most recycled consumer product followed by aluminum cans, which have a recycle rate of 55 percent. This phenomenal recycle rate leads many to consider lead acid battery chemistry as the environmentally friendly "green" choice.

From a broader perspective, achieving energy independence and reducing carbon emissions are closely tied to improving our ability to store electrical energy in a cost effective and practical manner. Substantial private and public resources are being invested in this pursuit and many of these developments will be introduced into the industrial lift truck market.

At this point, there doesn't appear to be one single stored energy technology that is the best solution for all possible industrial applications. And, as we have seen, there will always be price and functionality tradeoffs to consider. Lift truck fleet managers must carefully weigh the strengths and weaknesses of each option to make the right choice for their operation and budget.

Steve Spaar is the director of Marketing for the Americas at EnerSys, a global provider of stored energy solutions for industrial applications. Current product offerings from EnerSys include Ferro, SCR, and HF chargers, opportunity and fast charge battery and charger systems, Li-Ion batteries and fuel cell product solutions.

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Could Nickel-Zinc be the Next HEV Battery System?

AJ Dalola, Regional Sales Manager
PowerGenix

As hybrid electric vehicles (HEVs) continue to evolve, there are debates about the best battery technology choice for future vehicles. Today, the battery most commonly used in HEVs is nickel metal hydride (NiMH). NiMH was a significant step forward from the early HEV battery technologies such as lead acid and has been a good workhorse for the HEV market. However, it lags behind the power potential of newer technologies in HEV and pure electric vehicles.

Lithium-ion large format batteries have advantages for the next generation of electric and plug-in HEV automobiles, the most important being energy density. Yet many challenges including cost, safety, reliability, raw material availability and recycling need to be addressed. These challenges may impede the growth of both lithium-ion batteries and more broadly the electric vehicle market.

Many battery experts are now looking towards an emerging technology with a long history that has the potential to be a leader in the HEV battery power space: Nickel-Zinc. First introduced by Thomas Edison for use in electric vehicles during the early 20th century, rechargeable Nickel-Zinc (NiZn) battery technology was used effectively in electric vehicles until the combustion engine emerged as the technology of choice for automobile propulsion. However, with new breakthroughs in engineering, NiZn is showing potential today to become the new cost effective, safe battery solution for high power motor driven and portable electronics devices.

NiZn has many benefits relative to both Li-Ion and NiMH for HEV applications in cost, energy and power density, safety and recyclability. For example, a recent retrofit of a Toyota Prius that was shipped with a NiMH battery system to cylindrical NiZn cells yielded the following data:

Weight: NiMH = 53 Kg, NiZn = 31 Kg (41 percent reduction in weight)
Size: NiMH = 0.031 m3, NiZn = 0.024 (22 percent reduction in size)
Peak Power: NiMH = 20 kW, NiZn = 25.5 kW (28 percent increase in peak power)

When evaluating these multiple types of battery chemistries, it is important to look at performance across a variety of factors. This article explores the differences and similarities between NiMH, Li-Ion and NiZn batteries for HEVs as they stack up on energy density, cost, service life, power density, safety, weight and size, toxicity and recyclability.

Energy Density

Despite the conventional wisdom suggesting that lithium batteries have a significantly higher energy density than other comparable battery technologies, it is important to note that there is a trade-off between safety and energy density in Li-Ion batteries. The lithium cobalt batteries that are widely used in electronics have very high energy density but significant risk of thermal runaway. The newer generation, safer lithium batteries (lithium manganese and lithium phosphates) developed for transportation and higher power applications have a lower energy density than the earlier generation lithium cobalt chemistries.

Moreover, as the chart in Figure 1 demonstrates, the gravimetric energy density advantage of the lithium phosphates and lithium manganese systems is only slightly greater than the energy density of current generation nickel zinc formulations. On a gravimetric basis, while existing Li-Ion cells have the potential to reach high specific energy density ratings, the more relevant energy density rating is that of high discharge rated cells, which would be used in today's HEV marketplace. When a high discharge rated Li-Ion cell is compared with a high discharge rated.

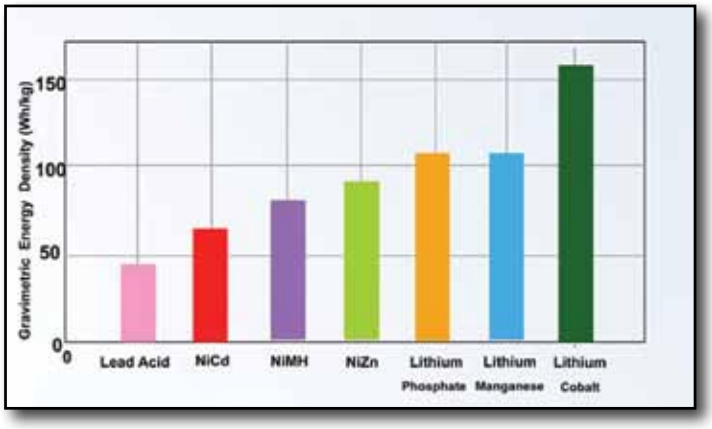

Figure 1. Energy Density

NiZn cell the disparity in the two data points become less significant. As a result, the energy density advantages of Li-Ion relative to NiZn for transportation can be comparatively small and may be outweighed by NiZn's cost and safety advantages.

Cost

As Figure 2 demonstrates, NiZn has significant cost advantages over both NiMH and Li-Ion batteries; about 25 percent less than NiMH and up to 50 percent less than Li-Ion. While the cost of Li-Ion cells will come down as production rates increase and the technology improves, NiZn is at the beginning of its own cost reduction curve and the solution cost for lithium battery packs will likely remain higher than nickel-based solution because of the expensive safety and supervisory circuits and packaging, as well as the complexities of the lithium battery manufacturing environments.

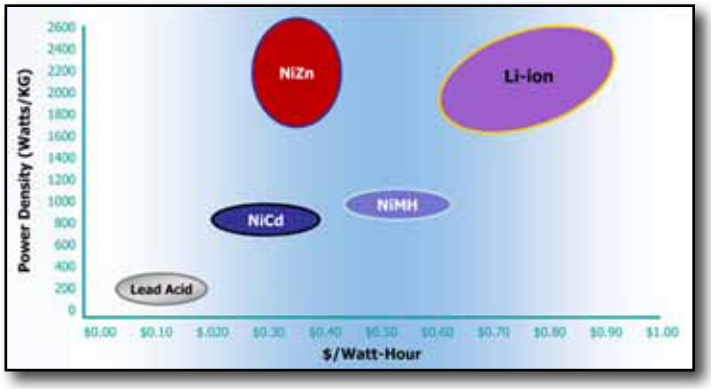

Figure 2. Cost

Service Life

HEV manufacturers specify battery technology with a service life that matches the vehicle warranty. This results in a typical requirement for a battery service life of ten years. On the surface, from the data that has been produced to this point, no one technology has a clear advantage in this category.

While lithium technologies usually are associated with superior cycle life characteristics, service life is a more complex requirement than cycle life alone. When an engineer analyzes other characteristics such as battery depth of discharge, heat generated during high current discharge, chronological battery capacity deterioration, capacity deterioration caused by long term storage and other similar factors, it becomes more difficult to ascertain a clear leader among NiMH, NiZn and Li-Ion battery technologies.

Power Density

Power density is an important factor in HEV applications. More powerful batteries deliver greater performance on demand and can be a real game changer in transportation as well as other applications.

One of the strongest advantages of NiZn is its high power density, due to the low internal resistance of NiZn cells. NiZn competes quite well against Li-Ion on a power density basis. As Figure 3 demonstrates, when comparing high discharge rated cells of both Li-Ion and NiZn, the NiZn system has an advantage. This is an important characteristic to consider for the HEV marketplace where battery discharge currents are high.

Another important factor to consider is the tendency of Li-Ion batteries to develop increased internal resistance as they age. This phenomenon would further erode the viability of Li-Ion's ability to deliver power as it ages.

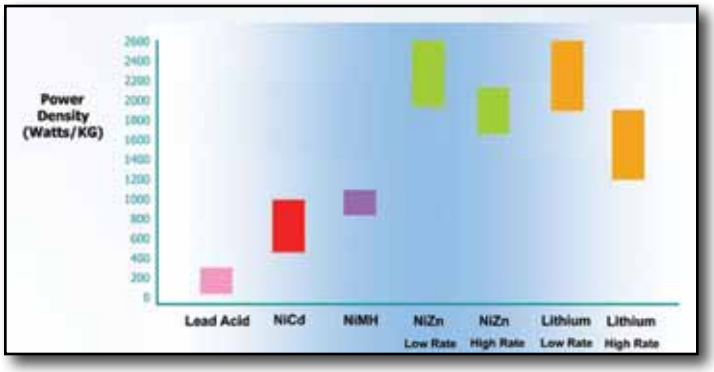

Figure 3. Power Density

Safety

Safety is one of the hottest issues in the HEV battery space, given the high risk situations in which these batteries are used. NiZn, NiMH and Li-Ion all provide varying levels of safety in this application.

NiMH: NiMH is relatively benign in comparison to lithium battery technologies because they use aqueous, rather than organic electrolytes.

NiZn: Similar to NiMH, NiZn batteries use aqueous, rather than organic electrolytes. NiZn takes safety an additional step forward by demonstrating that even when all battery constituents are extracted from a cell and exposed to an external flame, nothing in this constituency supports combustion.

Li-Ion: Although there have been advances in the safety of

lithium batteries in recent years, concerns still exist. The newer generation lithium manganese and lithium phosphate batteries have improved the exothermic behaviors associated with earlier lithium cobalt batteries, but they remain at risk to fire and explosion in fault conditions, such as battery case penetration, internal shorting cause by shock or vibration and excess temperature, which are not uncommon in the vehicle applications.

Weight and Size

Weight and size are important factors in HEV batteries, as they influence cost and performance. Because of NiZn's high cell voltage (1.6 volt /cell), it requires fewer cells to build a battery pack when compared to NiMH (at 1.2 volts/cell). Testing has indicated that a comparable NiZn battery system to the NiMH deployed today may be up to 40 percent lighter and 20 to 25 percent smaller in size. Li-Ion batteries can improve weight further, but at a significantly higher cost. For HEVs and some short electric-only range PHEVs, where the weight of the battery pack is not as crucial as it is in pure electric vehicles, NiZn's weight and cost equation may strike the right balance between NiMH and Li-Ion.

	Ni-Zn	Ni-Cd	Ni-MH	Li-Ion
Weight	2nd	3rd	3rd	1st
Size	2nd	3rd	3rd	1st
Power	1st	2nd	4nd	3th
Run Time	2nd	3rd	2nd	1st
Safety	1st	1st	2nd	4th
Cost	2nd	1st	3rd	4th
Toxicity	1st	4th	2nd	2nd
Recyclability	1st	4th	2nd	2nd

Figure 4. Competitive Matrix

Toxicity

NiZn and NiMH have aqueous electrolytes, which are nontoxic. Because of lithium's reactivity to water the Li-Ion batteries use a more toxic, less environmentally friendly organic electrolytes.

Recyclability

All the constituents of a NiZn battery are recyclable and benign. While both NiMH and Li-Ion batteries are also recyclable, care needs to be taken during shipping and handling of these batteries systems due to flammability of the constituent parts. Also, the rare earth metals of NiMH and the lithium in Li-Ion are not completely recoverable during recycling.

Conclusion

Nickel zinc battery systems have some clear advantages over existing NiMH battery systems and potential Li-Ion systems for HEVs. To recap, compared with traditional NiMH vehicle battery packs, NiZn can offer:

- 30 percent reduced battery weight and size,
- A 20 to 25 percent cost advantage (50 percent vs. lithium)
- Completely safe, nontoxic, recyclable and non-combustible chemistry.

Future testing will ultimately prove the most competitive battery technology to serve this marketplace, but most encouraging, it appears the number of chemistries to choose from may have now gained a new candidate, nickel-zinc.

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Write a Feature Article for an Upcoming Issue of Battery Power Magazine! Contact Shannon Given at Shannong@infowebcom.com

Electric Vehicle Battery Market: Exploring the Batteries Involved

Suba Arunkumar, Industry Analyst, Energy & Power Systems Group
Frost & Sullivan

Passenger cars have become ubiquitous. In 2008, we witnessed production of 53 million cars, accounting for 87 percent of the total motor vehicle production. Starting batteries, known as starting, lighting, ignition lead acid batteries, generated the highest revenues in the battery industry when compared with other chemistries. Despite being a well-established market with high growth potential in developing economies such as China, India, the Middle East and Brazil, the search for the right alternative to replace conventional gasoline-powered passenger cars has begun. Vehicle emissions and atmospheric warming are the primary reason to replace conventional combustion powered automobiles. In developed countries, various types of government and non-profit organizations are providing active support and promoting alternative vehicles powered by batteries. In addition to emission controls, a widespread use of these alternative vehicles creates a significant reduction in dependency of the fast depleting natural oil.

Advanced hybrid electric and electric vehicles (EVs) are expected to reduce the dependency of oil and improve air quality by limiting carbon emissions. The importance to these vehicles increases daily, and many government initiatives are being introduced to support and promote these vehicles. The European Union and the US are actively supporting these vehicles through various legislations, tax incentives and federal grant support. Because of these measures, the EV, and subsequently the EV battery market, has become one of the most dynamic industries in which most vehicle manufacturers and battery suppliers are participating.

Performance expectations for these vehicles grows each year, which increases the responsibility of vehicle manufacturers to deliver an EV that performs similarly to the available gasoline-powered vehicles. Since batteries form an integral part of these vehicles, it directly influences battery suppliers to develop the most efficient, reliable, lightweight, small-sized and cost-effective batteries. As the EV battery market emerges, manufacturers are in the R&D phase of developing different chemistries that could cater to all customer expectations and demand.

Batteries: An Overview

EVs are powered by different battery chemistries including lead acid, nickel metal hydride, sodium nickel chloride and lithium-ion. Each of these chemistries possesses distinct features based on its use for powering EVs. The ones developed during the initial stages of alternative vehicles used lead acid batteries, but with increasing use of these vehicles, other chemistries proved much more effective than lead acid. However, lead acid batteries have proved to be the most reliable battery chemistry available at an affordable price to customers. Low energy density is the major reason that dampens widespread use of this chemistry in EVs.

Extensive research is ongoing to improve the energy density of lead acid through modifications for electrode and electrolyte. Such batteries are noted as high-powered or advanced lead acid batteries, which are aimed to power EVs. Among the very few manufacturers is Firefly Energy, Inc., the company that has modified the electrodes of lead acid batteries. These batteries could power EVs at a lower cost than the competitive chemistries. However, when comparing based on the inherent features, lithium-ion is the chemistry most portrayed as a suitable battery for all types of EVs. A precise comparison of the major battery chemistries used in EVs is represented in the figure below.

Parameter	Lead Acid	Nickel Metal Hydride	Lithium-ion
Specific Energy (Wh/Kg)	30~40	60~90	100~200
Energy Density (Wh/l)	130~180	150~200	300~400
Cycle Life	300	400	500
Self Discharge Rate (%)	10	30	5
Energy Efficiency	70%	75%	99%
Operating Voltage (V)	2.0	1.2	3.7

Figure 1. Comparison of the major battery chemistries used to power EVs.

Note: Cycle life depends on the vehicle type and usage. Values refer to comparative advantage of lithium-ion cells.

Based on these comparisons, it is observed that lithium-ion batteries offer superior performance compared with other battery chemistries. However, the safety aspect of the lithium-ion battery is ensured through rigorous testing methods.

Exploring the Lithium-Ion Family

Lithium-ion refers to a family of batteries that have lithium as anode and different cathode materials. With increasing growth potential in EV applications, different cathode materials are evaluated that could satisfy all the demands and expectations of the user. Lithium cobalt oxide is the commonly used lithium-ion battery for consumer application. This chemistry is thermally unstable, which led to explosions in many consumer devices (specifically laptops). Recognizing this feature, battery manufac-

turers are developing lithium-ion batteries with alternative cathode materials such as manganese, iron phosphates, nickel cobalt manganese, titanium oxide and the like. Among these, the most widely adapted chemistry includes lithium manganese oxide and lithium iron phosphate that are developed by many battery manufacturers to power EVs. A comparison of these different chemistries within the lithium-ion family gives a fair idea on the type of application for which each battery is best suited.

	Lithium Cobalt	Lithium Manganese	Lithium Nickel Cobalt Manganese	Lithium Iron Phosphate
Operating Voltage (V)	3.7	3.8	3.6	3.2
Cycle Life	400	300	400	1000
Thermal Stability	Unstable	Fairly Stable	Fairly Stable	Stable
Energy Density (WH/Kg)	180	100	170	130
Most Suitable Application	Consumer Devices	EVs, HEVs & PHEVs	HEVs & PHEVs	EVs, HEVs & PHEVs

Source: Frost & Sullivan

Figure 2. Depicts the features of various lithium-ion chemistries.

As expressed in the Figure 2, lithium cobalt oxide is successful lithium-ion chemistry with unit volumes of billions of cells every month for consumer application. However, this chemistry is not suited for automotive application. The key difference between these batteries employed in consumer and automotive applications are listed:

- EV batteries require high energy capacity, mass and volume compared with batteries used in consumer applications.
- EV batteries are a part of battery management systems, in which monitoring and control processes are connected to the battery cells that are interconnected with each other to form a module.
- EV batteries are subjected to vehicle control system, during vehicle usage.
- A safety mechanism to automatically shut down the power supply from the battery is installed in EV batteries.

The responsibility, expectation and the output from an EV battery is much higher than those expected from a battery for consumer application.

Evaluation of Lithium-Ion Batteries

Lithium-ion batteries include different cathode materials, each with different distinct features. Each of these chemistries exhibits different results when subjected to a rigorous test process that could help in identifying the most suitable chemistry for the specific type of EV. The test procedure involved in evaluating these battery chemistries are listed:

- The testing process starts from testing the cells, followed by testing modules and then proceeding to testing packs.
- Subjecting the cells, modules and packs to constant current (the time taken by each chemistry to discharge from one voltage to another keeping the current constant) and constant power ratings (time taken by each chemistry to discharge from one voltage to another at constant power rating)
- Subjecting the cells, modules and packs to pulse tests at various state of charge
- Testing the cells, modules and packs to life cycle test to evaluate the charge discharge cycles it can operate
- Subjecting the cells, modules and packs to fast charging tests to evaluate the time taken by each chemistry to charge to 80 percent of its full capacity

The Figure 3 depicts a snapshot view of the performance of different chemistries from an end-user's perspective.

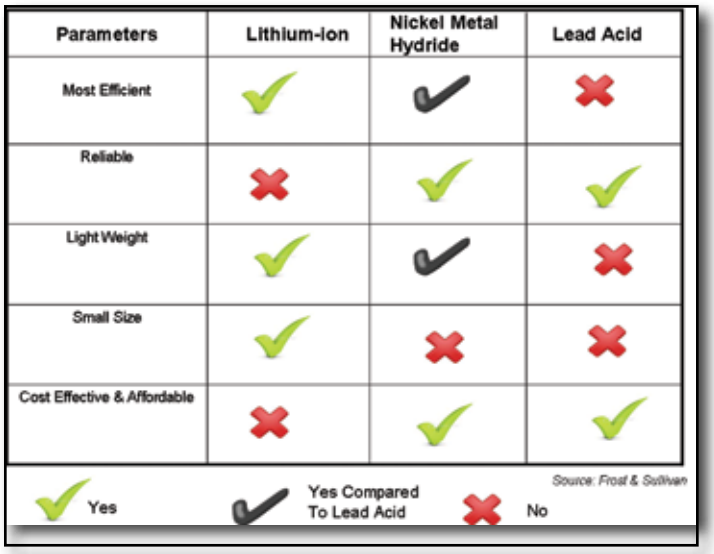

Figure 3. Evaluating Different Chemistries in End-user Perspective

Conclusion

Determining the best fit battery chemistry for powering EVs is a complex process in which different parameters need to be considered. After such careful evaluations, most of the battery manufacturers and EV makers concur that lithium-ion chemistry has good potential to cater to demands. However, as the market still emerges, lithium-ion battery chemistry is yet to prove its capabilities. With the development of the right chemistry at an affordable price, EVs have every possibility to change the dimension of automotive industry and make automobiles completely environmental friendly.

Contact Frost & Sullivan at www.frost.com.

Anode Materials in Lithium Ion Batteries

Mary Patterson, Research and Development
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For many years, lithium ion batteries have been used to power devices such as cell phones and laptop computers because of their high energy density. Today, lithium ion batteries are used in larger formats to power vehicles and store energy from the electrical grid. The major internal components of a lithium ion battery are the anode (negative material), cathode (positive material), separator and electrolyte. The focus of this article is the types of materials that serve as the anode in a lithium ion battery. The anode stores the lithium in the fully charged battery. It is critical that the anode material meets the technical requirements of the completed battery for the desired application.

Desired Characteristics

A large reversible capacity, which is defined as the difference between the initial capacity and the irreversible capacity, is desirable. This ensures that the resulting battery has a large capacity and when paired with a large voltage range for the full cell, also provides high energy. A low irreversible capacity is also advantageous. For an anode material, the irreversible capacity mainly refers to the lithium that is consumed during the formation of the solid electrolyte interphase (SEI) layer. Anode materials that operate at a voltage below about 1.5 V, including carbonaceous and silicon materials amongst others, react to form a coherent and protective SEI layer with the electrolyte. The SEI layer is formed during the first charging cycle of the cell and contributes to the irreversible capacity since it consumes lithium in its formation. It is electrically insulating but conducts lithium ions and ensures that no parasitic side reactions occur between the anode material and the electrolyte after the battery is formed. It also contributes to the safety of the battery. The composition of the SEI layer varies with the type of carbon and the electrolyte solvents and salt [1]. Compounds in the SEI layer include inorganic compounds such as LiF and Li_2CO_3, organic salts such as lithium alkyl carbonates, and organic species such as polymers. A thin, coherent, protective and stable layer that consumes as little lithium as possible is desirable. Some anode materials irreversibly bind a portion of the lithium during the first charging cycle of formation, which also contributes to irreversible capacity.

A good charge profile refers to not just the upper and lower voltage limits, but also to the shape of the charging curve. Some materials, like graphite, have a very flat charge/discharge profile, while other materials, like hard and soft carbon, have a sloping charge/discharge profile, as illustrated in Figure 1. A flat charge profile results in a higher average cell voltage, whereas a sloping charge profile can act as a good state-of-charge indicator, which may simplify the associated battery management system (BMS).

Each application for a battery has a desired rate capability, which refers to the kinetics of the lithium insertion and deinsertion processes. Materials that insert and deinsert lithium quickly are said to have good rate capability. Batteries used in applications such as hybrid electric vehicles (HEVs), where energy is captured during regenerative braking, require anode materials with good rate capability. Materials with a high charge rate capability can be recharged faster. Materials with a high discharge rate capability produce a battery that can deliver high power.

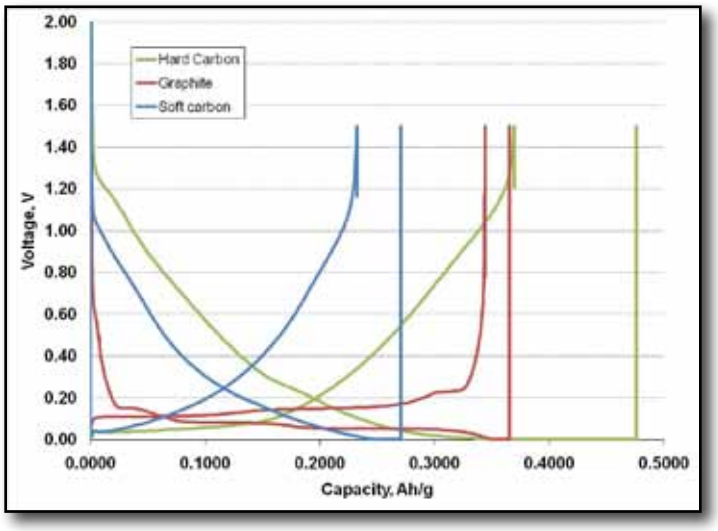

Figure 1. First charge/discharge cycle for half cells of graphite, hard carbon, and soft carbon.

A lithium ion battery is expected to have a long cycle and calendar life, so the anode material must be stable through many charge and discharge cycles over time. Capacity fade can result from a number of factors. If the SEI layer continues to grow through the lifetime of the battery, the interfacial resistance increases and the capacity and rate capability will be lowered. Volume changes associated with lithium insertion and deinsertion can result in mechanical damage to individual particles and cause capacity loss. Also, individual particles can become electrically isolated from the rest of the matrix, resulting in the loss of capacity from those particles. With time, the material can also fatigue and not intercalate or deintercalate lithium as effectively, again resulting in capacity fade.

The anode material can contribute to the overall safety of the battery. In general, an anode material with a higher onset temperature for exothermic reactions will result in a safer battery. Further, the material should ideally be non-toxic.

The anode material must be easy to process. It must be compatible with established binder and solvent systems and be easily mixed into slurry and coated on the metal foil current collector. Obviously, a lower cost material will result in a lower cost battery.

Material	Initial Capacity, mAh/g	Reversible Capacity, mAh/g	Irreversible Capacity, mAh/g	Typical first cycle efficiency, %
Graphite	360 to 390	330 to 360	15 to 30	92
Hard Carbon	480 and higher	370 and higher	90 and higher	77
Soft Carbon	275 and higher	235 and higher	40 and higher	85

Table 1. Comparison of typical specific capacities ranges for graphite, hard carbon and soft carbon.

Carbonaceous Materials

Most currently manufactured commercial lithium ion batteries use carbonaceous anodes. The three main categories of carbonaceous anode materials for lithium ion batteries are graphite, hard carbon and soft carbon. Graphite is familiar to everyone as pencil "lead" and has many industrial applications. It can be supplied as natural graphite or synthetic graphite. Figure 2 is a scanning electron micrograph of a natural graphite material. Soft carbon is manufactured using organic precursors such as cokes, coal-tar pitches and petroleum fractions that melt before they pyrolyze. Soft carbons are graphitizable; heating them to 3,000°C transforms them into graphite. Hard carbon is manufactured using organic precursors such as thermosetting polymers and natural materials such as sugar and cellulose, which char as they pyrolyze. Hard carbon is non-graphitizable; the structure is cross-linked and does not change to graphite when heated to 3,000°C.

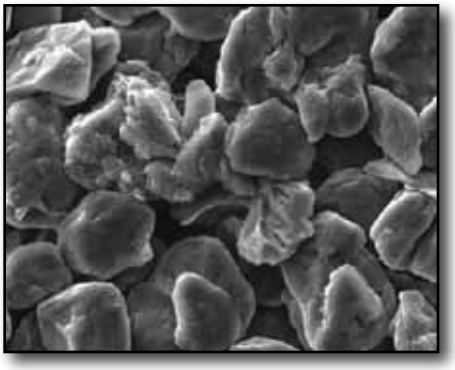

Figure 2. SEM micrograph of natural graphite. The image is approximately 100 microns by 80 microns.

Typical initial, reversible and irreversible capacities for graphite, soft carbon and hard carbon are shown in Table 1. The theoretical capacity of graphite, based on the formation of LiC_6, is 372 mAh/g. Soft and hard carbons have a very wide range of capacities due to the different insertion and adsorption sites that are present [2]. Graphites generally have the lowest irreversible capacity, followed by soft carbon, then hard carbon. The irreversible capacity represents the lithium that does not intercalate back into the cathode after the battery has been fully discharged. Some of the irreversible capacity is due to the SEI layer formation, and some is due to the irreversible adsorption of lithium.

In general, hard carbon and soft carbon have better charge and discharge rate capability than graphites. Also, the cathode material that the anode is paired with in a full cell influences the charge and discharge rate capability. Figure 3 shows the discharge rate of a non-graphitic carbon material paired with a spinel cathode or a mixed oxide cathode. It can be seen that the discharge rate capability of the cell is much better with the spinel material.

All three materials can produce cells that have good cycle life. Each material can exhibit a 90 percent capacity retention or better after 1,000 cycles of 2C cycling between 2.7 V and 4.2 V when paired with a mixed oxide cathode.

The particle shape, size and morphology including pores and pore shapes all have an effect on the performance properties of the anode material. Manufacturing conditions such as the heating temperature and time, the atmosphere under which the material is heated, and the heteroatom content and defect structure of the starting materials also all impact the performance characteristics [3, 4]. Also, all three of these carbonaceous materials are often modified with surface coatings to improve various performance characteristics.

LTO

Lithium titanium oxide ($Li_4Ti_5O_{12}$ or LTO) is an anode material with good rate capability and safety. Its spinel structure is very stable so it exhibits excellent cycleability. LTO exhibits

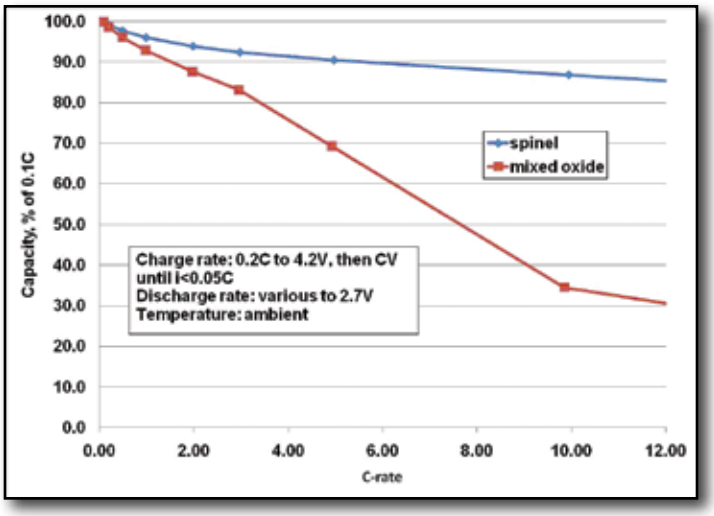

Figure 3. Discharge rate capability of a non-graphitic carbon paired with a spinel or a mixed oxide cathode.

almost no volume change when it is fully intercalated with lithium, changing into a rock salt structure. Its operating voltage is 1.5 V vs. Li/Li+, which is more positive than the voltage of SEI layer formation. Since no SEI layer is formed, LTO has a very low irreversible capacity. Since the LTO does not react with the electrolyte, there is no SEI layer to potentially breach in an abuse situation, which contributes to the safety of the LTO anode. However, because LTO operates at about 1.5 V, the average voltage of a battery employing LTO as the anode has an average voltage that is lower than one using carbonaceous anodes. The cost of LTO is also higher than carbon.

LTO has a reversible capacity of approximately 165 mAh/g and an irreversible capacity near zero. It has a very flat discharge profile with its plateau at 1.5 V. Its charge and discharge rate capability is excellent and it can be used in high power batteries.

Silicon

An emerging anode material for lithium ion batteries is silicon. It has the largest theoretical capacity for lithium insertion at about 4,200 mAh/g. The disadvantage of silicon is the huge volume change that occurs upon lithium insertion and deinsertion, of up to 300 percent by volume. This results in mechanical disintegration of the material and can severely limit the cycle life of the battery. Smaller particle sizes and flexible binder systems extend the cycle life of silicon anode materials. Recently, solid-state nanosilicon anodes have been synthesized that exhibit a large specific capacity and represent a binderless system that could be incorporated into an on-chip power source [5].

Nanomaterials

Nanomaterials are a popular area of research for use in lithium ion batteries. A nanomaterial is defined as a material with any dimension in the sub-micrometer range, preferably no larger than 100 nanometers. The potential advantages of nanomaterials include better rate capability and higher reversible specific capacity. However, the use of nanomaterials does create some technical challenges. The irreversible capacity of nanomaterials can be higher due to their high surface area. Also, the charge profile of many nanomaterials is very steep and lowers the average battery voltage that can be achieved. At the Electrochemical Society meeting in San Francisco last spring, many nanomaterial synthesis and characterization talks were presented at the Nanostructured Materials for Energy Storage and Conversion session. Among the anode nanomaterials discussed were silicon, carbon nanotubes, metal-carbon composites, transition metal oxides, and metal oxide-carbon composites.

Others

Many other materials are under investigation for use as anode materials. Some of these are tin, antimony and aluminum compounds; silicides, nitrides and phosphides; transition metal oxides; alloys and intermetallics. These materials generally have specific capacities larger than graphite.

Conclusions

Currently, the most prevalent anode materials used in production lithium ion batteries are carbonaceous and LTO. The next material that may be employed in high capacity batteries is silicon. Nanomaterials are currently being tested in research laboratories but will likely make their way into mass production in the future.

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Contact Mary Patterson at 317-585-3400 ext. 3024 or mpatterson@enerdel.com.

Custom 7.4 V, 1,900 mAh Li-Ion Prismatic Battery Pack for Portable Therapeutic Equipment

GlobTek has introduced a Li-Ion Prismatic battery pack rated 7.4 V, 1,900 mAh consisting of two Panasonic CGA103450A 103450 sized cells packaged in a custom enclosure with protection and fuel gauge circuitry included. The protection circuitry is designed by GlobTek based on a Seiko S-8232AKFT-T2 control chip while the fuel gauge and management is done by TI BQ27000 based circuits. The custom frame is made of a poly carbonate/ABS mixture, custom contacts made of nickel sealed in an ET label material.

The custom battery pack has onboard protection from short circuit, over voltage, over current, under voltage, overcharge, over discharge and over temperature. The battery delivers a minimum of 80 percent of its rated capacity after the first 300 cycles.

Infinite Power Solutions Introduces a Thin-Film, Solid-State, Single-Cell Battery

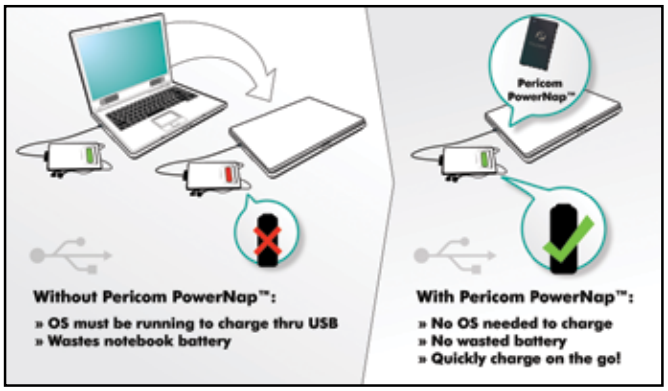
Infinite Power Solutions, Inc. (IPS) has recently introduced a powerful solid-state, thin-film, single cell battery, the Thinergy MEC102. The MEC102 provides a nominal 4 V output and features a unique, patented, flexible package design that maximizes the active area of the cell and minimizes the device footprint to deliver high energy and power density. With an expected lifetime of up to 20 years, Thinergy MECs require no maintenance or periodic replacement like other batteries, allowing the lowest total cost of ownership. Moreover, Thinergy MECs are eco-friendly and safe as they will not overheat, burn, leak or outgas. They can be deeply embedded since they last the life of the system.

The MEC102 is well suited for a number of micro-electronic applications including remote/autonomously powered wireless sensors, security systems, remote controls, memory and real-time clock back up, semi-active RFID tags and powered cards. It is also well-suited for military and aerospace applications, along with energy harvesting solutions and perpetual power systems.

The MECs can be stacked vertically in a series or parallel configuration for more power and capacity, without consuming additional system footprint. A five cell stack remains less than 1 mm in total height and delivers 500 mA of continuous discharge current (approximately 1.5 W of power). It can be charged to 90 percent in ten minutes, and efficiently accepts charge currents less than 1 microampere, making it well suited for storing harvested energy from small solar cells or other ambient energy harvesters.

BatteryJack's PowerStar Introduces a Sealed L16 Battery

BatteryJack's sealed lead division, PowerStar, has developed a maintenance free, non-hazardous and non-spillable battery for the common L16 size. The deep cycle battery's lead-calcium alloy plates inside ensures improved performance and long life. There is a dual terminal layout on the battery, consisting of a wing nut terminal and a standard automotive terminal. The 6 V, 390 Ah battery measures 11.61 inches by 7.09 inches by 16.85 inches and weighs 123 lbs.



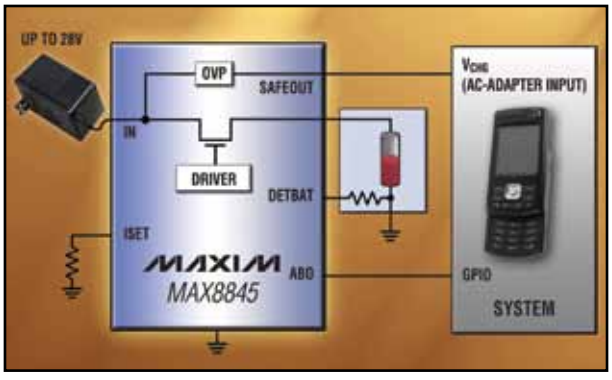
USB Sleep-and-Charge Solution for Notebook and Mobile Device Chargers

Pericom Semiconductor Corp. has released its new USB sleep-and-charge solution for notebooks and third party dedicated chargers for mobile devices.

New PowerNap technology allows the user to connect and charge USB-enabled handheld mobile devices without waking up the PC, and is also known as "sleep-and-charge" functionality. Pericom's PI5USB56 all-in-one USB PowerNap controller is the first of the PI5USB5X series with auto-detection and auto-switching support for mobile device charging, based on Pericom's new patent-pending PowerNap technology.

Additionally, with the PI5USB56 IC, system designers do not need to consider any software intervention requirements, since the IC supports automatic detection and switching.

PI5USB56 USB PowerNap controller fully supports USB1.1, USB2.0 full speed and high-speed specifications. It supports sleep-and-charge functionality per USB 1.0 charger spec, USB 1.1 charger spec, YD/T-1591 charger spec and non-standard charging methods implemented in products such as Apple iPhone. It also offers ESD protection and Vbus short protection.

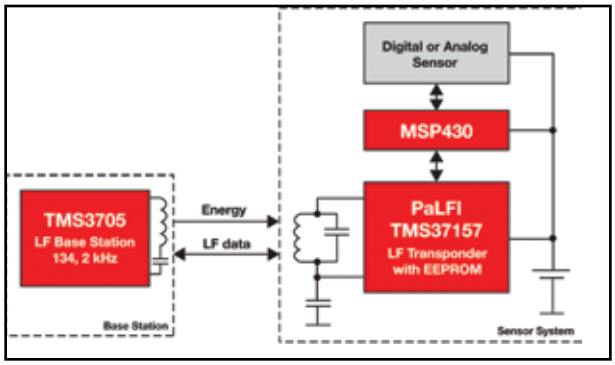


Dual-/Single-Input Battery Chargers with Battery Detection and Overvoltage-Protected Outputs

Maxim Integrated Products has introduced the MAX8844/MAX8845 28 V, dual-/single-input, linear Li+ battery chargers with battery detection and overvoltage-protected outputs. These devices enhance flexibility by providing resistor-adjustable fast-charge and top-off current thresholds. To further increase flexibility, an autobooting assistant circuit distinguishes input sources and battery connection, and also provides an enable signal for system booting. The MAX8844/MAX8845 are well suited for space-constrained applications such as cell phones and smartphones.

The MAX8844 has two overvoltage-protected LDO outputs for supplying low-voltage-rated USB or charger inputs, while the MAX8845 has a single overvoltage-protected LDO output. This integration eliminates the need for external overvoltage-protection ICs. Both devices integrate a battery-pack detection circuit that disables the charger when the battery pack is absent.

The MAX8844 is packaged in a 3 mm by 3 mm, 14-pin TDFN, while the MAX8845 is available in a 3 mm by 3 mm, 12-pin TQFN package. Prices start at $1.42 (1,000-up, FOB USA). User-friendly evaluation kits are available to speed designs.



Passive Low Frequency Interface with Battery Charge Function Enables Remotely Powered Medical, Industrial and Consumer Products

Texas Instruments (TI) has announced the first member of a new product class featuring a passive low frequency interface (PaLFI) device designed to wirelessly supply an ultra-low-power MSP430 microcontroller (MCU) with energy to operate even if the optional battery is empty. For example, PaLFI has the ability to remotely communicate with and power implantable medical devices, making procedures less invasive. Among numerous other potential applications, the device is also being used for production chain or container tracking and end of line configuration of electronic equipment such as CD/DVD players and measurement instruments.

The TMS37157 PaLFI is priced from $3.10. The device comes in a 16-pin QFN package. The PaLFI evaluation kit eZ430-TMS37157 contains an eZ430 MSP430F1612 USB development stick, and an MSP430 target board including an MSP430F2274 plus the TMS37157 PaLFI.

Linear Technology Announces the Missing Link for Energy Harvesting Applications

Linear Technology Corp. has released its first device in a new family of power management products for energy harvesting applications. The LTC3108, an ultralow (20 mV) input voltage DC/DC converter and power manager, is designed to interface with thermoelectric devices that convert small temperature differentials into electrical energy and convert that energy

into a usable form for powering a wide range of applications.

Energy harvesting affords the opportunity to charge, supplement or even eliminate batteries in systems where they are inconvenient, impractical, expensive or dangerous. It can obviate the need for wires and routine maintenance.

Energy from ambient temperature gradients can be harvested from such disparate sources as heating ducts and radiators, engines and motors, friction sources and the human body. Application areas include building automation, avionics, automated metering, remote sensor installations, predictive maintenance and wearable electronics.

Single- and Dual-Cell Li-Ion and LiFePO4 Chargers with OVP Enable Safer, Longer-Lasting Portable Devices

Microchip Technology, Inc., a provider of microcontroller and analog semiconductors, has announced two families of charge-management controllers featuring overvoltage protection (OVP), which prevents overheating and damage to the battery-charger circuit from input-voltage spikes. The MCP73113, MCP73114 and MCP73213 Lithium-Ion (Li-Ion); and MCP73123, MCP73223 Lithium Iron Phosphate (LiFePO4) chargers feature high-accuracy voltage regulation and an integrated pass transistor. The combination of features enables smaller, safer portable electronic device designs with longer run times for the consumer, medical and industrial markets.

Microchip's new chargers address increased consumer focus on the safety and efficiency of battery-powered applications. All of the new devices have a maximum input voltage of 18 V and come with one of two OVP set points: 5.8 V and 6.5 V for the single-cell MCP73114 and MCP73113/23 chargers; or 13 V for the dual-cell MCP73213 and MCP73123 chargers. Additionally, the MCP73113, MCP73114 and MCP73213 devices provide a variety of charging-voltage options for Li-Ion batteries: 4.1 to 4.4 V for the single-cell and 8.2 to 8.8 V for the dual-cell devices. The MCP73123 and MCP73223 devices target LiFePO4 batteries, and offer charging-voltage options of 3.6 V and 7.2 V, respectively.

The MCP73113 and MCP73114 Li-Ion, and MCP73123 LiFePO4 single-cell chargers feature high-accuracy voltage regulation of 0.5 percent; the dual-cell MCP73213 Li-Ion and MCP73223 LiFePO4 devices 0.6 percent. These accuracy levels of regulation enable longer battery life per charge, ultimately allowing portable products to run for longer periods of time between charges.

LEM Announces Sentinel III Portfolio of Comprehensive Battery Monitoring Components

LEM S.A., a manufacturer of isolated current and voltage measurement components, has released the Sentinel III; an advanced set of components for a battery monitoring solution that addresses the needs of uninterruptible power supplies (UPS) and battery provider OEMs, as well value-added resellers (VARs) and systems integrators. Sentinel III components are used to create a simple to install and intuitive solution for continuous battery monitoring within mission critical installations such as hospitals, airports and datacenters.

The Sentinel solution combines transducers, data loggers and software components to create a comprehensive, yet simple and cost effective, standby battery monitoring solution (SBM). In order to extend the functionality of its existing Sentinel, LEM has developed the S-BOX; an advanced data logger featuring an embedded Web server, which enables administrators to monitor installations remotely. The S-BOX measurement and data logging features include Bloc, string and battery voltage measurement, Bloc temperature and impedance measurement, discharge performance and discharge/charge current. The S-BOX also measures ambient temperature, a key factor affecting battery life.

The new Sentinel transducer is designed to reduce installation time, offering DIN-rail mounting and an external temperature patch. Users can set up an alarm for each of the parameters measured by the transducers connected to the S-BOX. As well as instant alarms the S-BOX can also provide a weekly report to the administrator, containing all daily measurements and critical system information.

IntelliBatt Launches New Branded Turnkey Package For Battery Backup Power

IntelliBatt has released a new set of turnkey solutions for data centers, telecommunications and others that will reduce battery systems costs up to 35 percent, as well as reducing the hidden cost associated with managing multiple vendor services.

Proven for more than a year in the field, release 2.0 now covers more than 3,500 IntelliBatt monitor nodes installed across multiple data centers in the US. IntelliBatt holds three recently allowed patents related to the monitor, how it measures data and embedding the circuitry of the monitor into the battery case.

IntelliBatt monitoring taps into the world's largest database for battery performance, which provides quick view analysis of hundreds of live sites to identify potential trouble points before they lead to failure. This service provides customers with real-time data and/or professional battery reports (alerts) through any Web browser, fixed or mobile, powered by IntelliBatt's sister company, Data Power Monitoring Corp.'s patented Battery Automated Reporting (BAR) system.

"Battery power is often described as the Achilles heel of a data center since nearly 85 percent of all UPS failures are caused by battery failure," said Steve Cotton, IntelliBatt co-principal. "Our customers must have 100 percent uptime for their applications, to deliver on service level agreements to their customers, which is why we've designed a battery monitoring solution that closes the loop between data collection and intelligent use of the data collected."

To date, BAR has tracked more than one million battery cells. The BAR interface works with all leading industry battery monitor offerings and incorporates key battery related IEEE standards into its technology and methodologies.

Featuring front access terminal batteries in UL listed cabinets, IntelliBatt has re-engineered battery and monitoring installation by pre-installing at the factory, which reduces the complexity of installation and cost.

IntelliBatt also takes a fresh approach on preventative and corrective maintenance. Traditional systems provide only a temporary indication of the battery condition through periodic manual monitoring, but IntelliBatt's battery monitoring system offers cost-effective daily monitoring, and thereby reduces scheduled preventative maintenance visits saving thousands of dollars per annum while also extending the life of the battery asset from six to 24 months longer.

Lithium Battery Gliders for 10 mm to 24 mm cells

MPD is introducing a whole new category of battery holders for lithium coin cell batteries. Gliders are a hybrid type combining the low cost of retainers with higher reliability than regular coin cell battery holders. They are particularly suitable for hand-held consumer and medical products, electronic cards, electronic toll tags, single-use devices, alarm systems, main boards, PND's and RFID.

Gliders are available immediately in 20 styles ranging from 10 mm diameter (CR1025) to 24 mm diameter (CR2430). Versions that hold two batteries in series for 6 volt applications are also included in the product launch, giving MPD Gliders a capability unmatched by prior retainers.

With versions available with either printed circuit pins or SMD leads, most layouts are accommodated. The retainer is made of nickel-plated phosphor bronze and has pressure contacts that offer low electrical resistance and are optimized to keep a tight connection with the battery. The battery is easily changed without tools or instructions due to the intuitive design.

Built-in circuit protection eliminates the drawbacks associated with standard coin cell battery holders as the holder prevents an electrical connection by the battery when upside down. The ultra light weight plastic body has a physical feature for reverse polarity protection. List price starts at $0.28 each for 1,000 pieces, and volume discounts are available.

New Insulated Coin Cell Retainer for 3 or 6 Volt Applications

A new series of insulated low profile coin cell retainers, suited for high density PCB packaging is the latest Keystone Electronics Corp's product for surface and thru hole mount battery retainers.

The design protects the battery from shorting if inserted incorrectly. These retainers also allow the user to stack two 20 mm cells on top of each other to achieve 6 volts of power from the same board footprint or for single cell 3-volt applications. The retainers are rugged yet lightweight, with clearly marked polarity, and are designed for both lead free solder and traditional reflow processes. The solder tails located outside the insulating material, support visual inspection systems.

Alpha Technologies Introduces Advanced Modular Power Systems

Alpha Technologies has introduced the Alpha Modular Power System 80HP (AMPS80), an AC or hybrid AC/DC power supply for ensuring system continuity. The unique design of the AMPS80 offers telecom grade reliability, up to 94 percent power efficiency and high power density through a scalable, modular platform with an intelligent system controller.

AMPS80 is offered in three-phase, two-phase and single-phase configurations to power up to 75 kVA loads utilizing 2.5 kVA inverter modules. Optional 1.8 kW rectifier modules may also be added on the same rack to create a hybrid AC/DC power system.

Alpha's smart unified controller with integrated Ethernet/SNMP interface monitors and manages both the inverter and rectifier modules through a web based GUI and local LCD touch screen. The controller also features Email notification via TCP/IP, user definable alarms and data logging, flexible battery management features and smart peripheral monitoring features.

Eltek Valere Brings High Efficiency Power Solution to Wireless, Central Office Networks with Modular HE Power System

Eltek Valere has brought its high efficiency (HE) technology to central office and wireless applications with the launch of the Flatpack2 High Efficiency (HE) modular power system.

Wireless towers, shelters, remote switching units (RSUs) and small central offices all face increasingly complex equipment to meet bandwidth requirements for advanced network applications. The increase in power density of network equipment has required an increase in capacity of the power plant, as some shelters now require up to four times the previous needs of 150 to 300 amps. Introducing a high efficiency product is well suited to combat this situation.

The Flatpack2 HE Modular 1212U power system supports up to 1,200 amps of power with up to 80 plug-in breaker/TPS fuse positions. The addition of a 24 V to -48 V converter shelf allows the system to support all wireless voltage applications while providing 120 amps of -48 V capacity to a customer configurable quantity of loads. A low voltage load disconnect feature extends back up battery power during an outage by automatically disconnecting low priority systems until power is restored.

The Flatpack2 HE Modular 1208U power system is also configurable for up to 1,200 amps of power, but with 48 plug-in breakers or TPS fuse positions. It also allows for dual voltage operation through use of the same 24 to -48 V converter shelf, which is capable of providing up to 120 amps of -48 V capacity and up to seven breaker positions. A low voltage battery disconnect feature allows for the customer to protect equipment from low voltage conditions during an extended power outage.

C&D Technologies Awarded Contract to Supply Back-Up Power for Beijing Metro System

C&D Technologies, Inc. has been awarded a contract to supply back-up power to the Beijing Metro as the system is expanded through the latest Lang Fang, Fang Shan, Da Xin and Yi Zhuang projects.

In this newest expansion phase, more than $1 million of high-rate uninterruptable power supply batteries will be employed to ensure that communications, security, central control and fire systems, all essential components of metro system management, will still function should a loss of main power occur in the Beijing Metro system.

Building on C&D Technologies' success as a supplier of back-up power to the Shanghai Metro system, the Beijing Metro award further establishes C&D as a supplier of choice for future metro and light rail expansion in China, and more broadly throughout Asia as governments invest heavily in transportation infrastructure for the future. The Beijing Metro is the oldest and busiest subway in China carrying more than five million passengers a day, and is the second longest in China, after the Shanghai Metro system. The Beijing Metro, like the Shanghai Metro system, is expanding rapidly, and the entire network is planned to double in size by 2012.

C&D is investing in new product and manufacturing capacity for the Asian market at its battery manufacturing plant in the Pudong region west of Shanghai. The plant, which was completed in early 2008 and includes world-class environmental systems, is one of the largest and most modern industrial battery manufacturing plants in the world.

Sion Power Receives DOE Grant to Enhance Lithium Sulfur Batteries

Sion Power Corp. has received a three-year, $800,000 research grant from the US Department of Energy (DOE). The monies are being used to support Sion's ongoing work to develop a new class of electrolytes used in lithium sulfur (Li-S) batteries for electric vehicle (EV) applications. Sion Power will provide matching funds for this three-year effort.

The project objective is to increase performance of very high energy lithium metal anodes used in rechargeable battery systems. Sion Power will complete development of its unique electrolyte system employing multiple components. While improving lithium conductivity, one component will be optimized to enhance metallic lithium anode performance; another will enhance cathode functionality. The multi-component electrolyte system will enable Sion Power to improve chemical stability leading to improved safety and abuse tolerance.

According to Sion Power's CEO Dennis Mangino, "We consider the receipt of this grant by the DOE a vote of confidence in the future of our advantaged Li-S rechargeable battery technology. There is no known commercial technology that will be able to match the electric vehicle driving performance enabled by Li-S batteries once targeted hurdles of cycle life and safety are overcome. This grant is key in helping to make that a reality."

Li-S technology already offers significant specific energy advantages over existing rechargeable battery technologies. Sion Power is currently completing development of a range of battery materials which improve Li-S battery life and extend driving range. The higher energy available with Li-S chemistry has the potential to extend significantly driving ranges over that available, or projected, with rechargeable lithium ion (Li-ion) battery technologies by a factor greater than three.

All major automotive manufactures are vigorously pursuing the introduction of electric vehicles that are environmentally friendly yet provide the range and comfort consumers expect in automobiles. These criteria cannot be obtained today with any commercially available battery technology. Sion Power is focused on being the first rechargeable battery company to do so.

ExxonMobil Affiliate and Toray Industries to Form Global Battery Separator Film Joint Venture

ExxonMobil Chemical's affiliate TonenGeneral and Toray Industries have agreed to establish a global joint venture for the battery separator film business. It will develop, manufacture and sell lithium ion battery (LIB) separator film and introduce next-generation films to the market.

The joint venture will combine Toray's plastic film processing and polymer science capabilities with Tonen's existing lithium ion battery separator film business and technology. It will build on ExxonMobil's more than 20 years of experience and success in providing separator films, including for use in the personal

electronics market, as well as support the development of future LIB applications in hybrid-electric and electric vehicles.

"We believe the joint venture will accelerate the development of separator film technology to support the rapidly evolving lithium ion battery market faster than either company could do alone," said Jim Harris, senior vice president ExxonMobil Chemical Company.

Detailed agreements are being prepared in anticipation of the joint venture formation in January 2010. TonenGeneral and Toray Industries will each hold a 50 percent interest in the joint venture, with headquarters located in Tokyo.

"We are confident that Toray's innovative ideas and technologies will enhance the capability of the joint venture to capture growth and meet the needs of the growing LIB market," said Sadayuki Sakakibara, president, CEO and COO, Toray Industries, Inc.

EnerDel Wins US Army Contract to Develop Batteries For New Hybrid Humvee

Automotive lithium-ion battery maker EnerDel, Inc. will be working with the US Army to develop a next-generation battery system for the hybrid version of the High Mobility Multipurpose Wheeled Vehicle (HMMWV or Humvee), known as the XM1124 Humvee. The company, a subsidiary of Ener1, Inc., has received a $1.29 million contract to design and build high-performance lithium-ion battery systems for two different applications, drawing on its expertise in multiple-chemistry solutions and ability to provide a complete architecture in cell chemistry, electronics and battery systems design.

"This is an opportunity to showcase the true capabilities of the EnerDel technology in conditions that demand the highest levels of safety, performance and reliability," said Rick Stanley, EnerDel president. "In keeping with a long tradition, we also expect that innovations perfected here will have important benefits for the commercial markets."

EnerDel will spend the next 18 months collaborating with the US Army Tank Automotive Research, Development and Engineering Center (TARDEC) to produce four custom-built power systems that will be subjected to extreme performance simulations.

TARDEC will be testing two of EnerDel's battery chemistries. In addition to its lithium-manganese spinel chemistry, best suited for extending electric vehicle range or electronic systems runtime, the program will also be testing EnerDel's lithium-titanate system, an advanced chemistry developed in collaboration with Argonne National Laboratory in Chicago, designed for extreme high-power hybrids that require hard acceleration and braking.

While the XM1124 Humvee is already significantly more efficient than the conventional M1113 Humvee, boasting a higher top speed, faster acceleration, longer range and improved fuel economy, expectations are that the new, upgraded battery packs will greatly increase the peak power capability of the current demonstration vehicles.

In addition, the robust battery technology will also include an all-electric "silent watch" capability which will power the electronics or traction motor without running the truck's diesel generator, significantly reducing both the audible and thermal signatures of the vehicle, making it easier to escape detection by hostile parties. An EnerDel-equipped XM1124 Humvee could also function as a portable power plant to power a mobile command post or field hospital.

Johnson Controls-Saft to Supply the Battery for Transit Connect Electric Vehicle

Johnson Controls-Saft has been chosen as the Lithium-ion battery supplier for Azure Dynamic's Force Drive integration on the Ford Transit Connect Battery Electric Vehicle (BEV). The all-electric van will be in production beginning in late 2010.

"Johnson Controls-Saft is committed to the commercialization of hybrid and electric vehicles," said Ray Shemanski, who leads the Johnson Controls-Saft joint venture and is vice president and general manager of Hybrid Systems for Johnson Controls. "We are proud to be chosen for the BEV and we look forward to strengthening our partnership with both Azure and Ford Motor Company to advance these leading-edge technologies. This partnership is underscored by our investment of more than $600 million in manufacturing and infrastructure development."

Commercial transportation in an urban environment accounts for 12 percent of total miles driven, yet is responsible for 25 percent of total greenhouse emissions. The Transit Connect BEV would eliminate gas costs and enable fleet owners to more accurately forecast the cost of doing business. It has a targeted range of 80 miles on all-electric power, and is the first of four electric vehicles Ford plans to build in its global commercial vehicle program.

"We've worked with Johnson Controls-Saft on our Balance Hybrid Electric delivery and shuttle bus project, and are confident that their batteries offer a light, powerful design with a longer life than most current battery technologies," said Curt Huston, Azure Dynamics chief operating officer. "Both Azure and Ford have existing relationships with Johnson Controls-Saft, bringing further synergies to the project."

In addition to its work with Azure, Johnson Controls-Saft is in production with the Mercedes S-Class hybrid, currently on sale in Europe and the US. Johnson Controls-Saft also will supply the Li-ion hybrid batteries for the BMW 7-Series Active-Hybrid available in 2010 and Ford's first plug-in hybrid electric vehicle available in 2012. The Transit Connect BEV will use the same battery technology that is currently installed in the Ford Escape test fleet of plug-in hybrid electric vehicles, also supplied by Johnson Controls-Saft.

Valence Technology and Electric Vehicles International Reach Exclusivity Agreement

Valence Technology, Inc. has reached an exclusive supply agreement with electric vehicle manufacturer EVI.

"The Valence U-Charge energy storage systems offers EVI the flexibility to offer three distinctive electric trucks from class 4 (15,000 lbs.) to class 6 (25,950 lbs). Customers also have the flexibility to select specific operating ranges from 60 to 115 miles to fulfill their specific service needs," said Robert L. Kanode, president and CEO of Valence Technology.

Since 2005, Valence has shipped nearly 80 megawatt-hours of energy, or the equivalent of approximately 4,000 electric cars. Valence Technology's energy storage solutions can be found in commercial electric vehicles from EVI, Smith Electric and PVI (in partnership with Renault Trucks), as well as in Brammo electric motorcycles, Oxygen scooters, Segway personal transporters, Tennant floor scrubbers and other advanced alternative transportation solutions.

Micro Power Awarded Two New Patents For Battery Pack Technology

The US Patent Office has awarded Micro Power Electronics two new patents covering innovative design techniques and manufacturing practices for battery packs. These patents improve the safety and reliability of the portable battery packs produced by Micro Power for mission critical operations.

One of the newly issued patents is for Micro Power's redundant battery protection system and method covering an enhanced protection system, which addresses a potential weakness of a conventional protection system in a conventional battery pack. The enhanced protection system includes both a primary protection circuit and a redundant protection circuit. The components of the redundant protection circuit are electrically coupled in parallel with the primary protection circuit. If the primary protection circuit fails, the redundant protection circuit will still operate to allow the enhanced battery pack to function. This patent ensures that battery packs will operate when called into action, even if there is a component failure that would typically fail a conventional battery.

The additional newly-issued patent is for Micro Power's electrical insulation system and method for power storage component separation, which includes an electrical insulation method for electrical separation of power storage components. This patent describes the use of polyurethane elastomer material to electrically separate various components of electrical power storage components within battery packs.

These components can include cells, connecting tabs, printed circuit assemblies, solder joints, nickel strips and other conductive members within the battery pack. This patent ensures the performance of battery packs when they are subject to abusive conditions such as shock or vibration.

EnerSys Acquires Oerlikon Battery Business

EnerSys has completed the acquisition of the industrial battery businesses of the Swiss company Accu Holding AG.

Enersys acquired the stock of OEB Traction Batteries and the operating assets and liabilities of Oerlikon Stationery Batteries, along with its Swedish sales subsidiary. The companies, which operate under the name Oerlikon Battery, supply high integrity solutions worldwide and have combined revenues in excess of $50 million per year.

"As we have noted previously, with our strong financial position we view the difficult economic environment as an opportunity for us to acquire good companies, with quality products and experienced people to help us extend our market leadership in industrial energy storage," said John Craig, chairman, president and CEO of EnerSys.

Die Systems from EDI Emerge as Key 'Enabling Technologies' for Fuel-Saving Lithium-Ion Batteries in New-Generation Automobiles

The key to achieving a renewable alternative to fossil fuels for transportation is the development of compact, lightweight, high-efficiency lithium-ion batteries that can perform for years through thousands of charging cycles. Extrusion Dies Industries, LLC (EDI) now supplies die systems that produce the exceedingly precise coating and film layers required for the multilayer structures within such batteries that actually do the job of storing and supplying electrical power.

"We see ourselves as providers of enabling technologies for manufacturers seeking to increase battery efficiency, reduce weight and cost, and ensure reliability," said Dennis Paradise, EDI's vice president of sales and marketing. "EDI brings years of experience in developing film and coating die systems for batteries, as well as for other critical multilayer electronic applications like flat panel displays and solar panels."

Dies are the shaping tools used by manufacturers to transform molten plastic into film or to apply functional coatings onto film, metal foil, or other substrates. EDI works on perfecting these processes with manufacturers of lithium-ion battery components at their own facilities. Among EDI technologies is a method for simultaneously applying anode and cathode electrode coatings to both sides of a substrate, enabling manufacturers to increase productivity.

A lithium-ion battery pack is a network of cells, each of which contains a multilayer structure of foils and films that typically is wound into the familiar cylindrical shape. Manufacturers use EDI coating dies to apply primer and electrode coatings to foil substrates and film dies to produce the thin, micro-porous films that separate electrodes while permitting the passage of electrically charged ions.

EDI's work on lithium-ion batteries began in 2002 with the first of four US Department of Defense contracts for optimizing production of batteries for devices carried by soldiers. The work involved building and operating a pilot coating line specifically for battery development. Since then the company has provided technology to producers of batteries for a range of consumer electronics applications and is now also working with suppliers to the automotive industry.

Neah Power Fuel Cell Chargers Deliver Renewable Back-Up Power for all Battery Systems

Neah Power Systems, Inc. has demonstrated Neah's methanol fuel cell as a battery charger of a majority of current battery-based systems, including traditional 12 V VRLA battery, nickel cadmium, nickel metal hydride, lithium ion, nickel zinc and other rechargeable battery platforms, which may be used for consumer, industrial, and military markets, electric scooters and golf carts.

While Neah's fuel cell can power external devices directly, this new capability enables the fuel cell integration in most existing low power platforms (battery-based systems).

Dr. Tsali Cross, Vice President of Engineering, said, "Many applications will require integration of our fuel cell with existing batteries, without a major effort needed to redesign a product. So I am pleased we have shown that Neah's fuel cell can be tailored to work with conventional power sources with the added benefits from a fuel cell such as increased mission duration, powering devices away from the grid and use of renewable fuels."

Coulomb Technologies Charging Stations for Electric Vehicles Come to Australia

Coulomb Technologies has signed ChargePoint Pty Ltd to an exclusive distribution agreement in Australia. ChargePoint Pty Ltd now offers Coulomb's ChargePoint Networked Charging Stations throughout Australia and is currently in advanced discussions with a number of government and private sector partners for pilot projects in Perth, Sydney and Melbourne, which are all due to commence in the first half of 2010. The pilot projects will be used to evaluate charging behavior, energy grid load analysis and environmental and societal impacts.

The first mass produced electric vehicles will arrive in Australia in 2010. Most manufacturers expected to release models in 2012, which will create demand for ChargePoint Networked Charging Stations in the local market.

Senior Research Fellow in smart grids and electric vehicles from Curtin University in West Australia, Dr. Andrew Simpson, says not only will consumers benefit from electric vehicle transportation, this technology will also improve the management of network loads for energy providers.

"Numerous studies have shown that there is the capacity for many electric vehicles to charge at off-peak times which can utilize grid assets more-effectively. This means cheap energy can be sold to electric motorists through infrastructure such as the ChargePoint Network.

Send your industry news items and new product announcements to Shannon Given, Director of Content, at Shannong@infowebcom.com.

Calendar of Events

February

2nd - 5th • 1st European Advanced Automotive Battery Conference
Mainz, Germany

21st - 25th • APEC 2010
Palm Springs, Calif.

March

3rd - 5th • 1st International Rechargeable Expo Battery Japan
Tokyo, Japan

15th - 18th • The 27th International Battery Seminar and Exhibit
Fort Lauderdale, Fla.

May

17th - 19th • BATTCON International Stationary Battery Conference
Hollywood, Fla.

17th - 21st • 10th International Advanced Automotive Battery Conference
Orlando, Fla.

June

5th - 10th • INTELLEC 2010
Orlando, Fla.

September

21st - 24th • 12th European Lead Battery Conference
Istanbul, Turkey

29th - 1st • Batteries 2010
French Riviera

October

19th - 20th • Battery Power 2010
Battery Power 2010 is an international conference highlighting the latest developments and technologies in the battery industry.

This eighth annual event will feature more than 35 presentations on portable, stationary and automotive battery technology, as well as battery manufacturing, materials and research & development.

Topics will include new battery designs, emerging technologies, battery materials, power management, charging and testing systems, battery health, as well as the latest market trends affecting the industry.
Dallas, Texas

Powering Electric Vehicles

Chad Hall, COO
Ioxus

Better and more efficient power sources have been a driving force behind research in battery technology, capacitor technology and electronic power supply design in the automotive industry. Utilizing this energy as efficiently as possible is a main priority. Automotive engineers began to do this by reducing the gross weight of an automobile by replacing metal trim molding with lighter composite materials and by using lighter metals when possible, such as replacing copper core radiators with aluminum core radiators. These early efforts proved valuable but were just the beginning of better energy efficiency in automotive design. The obvious alternative power source is the battery, but the size and weight of batteries required for an all-electric car were, and are still, not available. The next best approach was a hybrid power plant, a power plant that uses a small internal combustion engine (ICE) in concert with a battery pack. It is fair to say that hybrid power plants have come a long way in the last five years, however they still leave a great deal to be desired.

The internal combustion engine has remained dominant in the automotive industry because it has very high energy density (gasoline) and very high power density controlled by the rate of fuel ignition. This combination of energy and power density does not exist for batteries or fuel cells. Gasoline also has an energy density of around 45 MJ/kg while most batteries have energy densities around a few MJ/kg. Thus, it is not surprising that the latest entries into the energy efficient power plant still have an ICE component. In order to make batteries and fuel cells more attractive, their overall performance must be increased.

The use of ultracapacitors is nonetheless a partial solution. It is widely known that pairing an ultracapacitor with a battery will improve the power density of hybrid supply, which has the added advantage of allowing the battery to operate without seeing large current spikes that would be present in the absence of the capacitor. The ability to prevent the battery from experiencing these large current spikes under load allows the battery to have a longer effective life. A typical starter battery, for example, will degrade very quickly if it is required to supply high current for any length of time. So-called deep cycle batteries are designed specifically to supply higher currents, but even such batteries with thicker lead plates are not immune from damage due to repeated deep cycling. A parallel configuration of a battery with an ultracapacitor can dramatically reduce the deep cycling of the battery under heavy load conditions and thus extend the life of the hybrid power supply, as well as providing a more efficient supply.

There is, however, more to the story. In most instances it is necessary to construct a "smart" supply; generally speaking, it is necessary to do more than just connect a battery in parallel with an ultracapacitor and hope for the best. The typical ultracapacitor has a voltage rating of 2.5 to 2.7 volts and for higher voltage applications the ultracapacitors must be configured in series strings for higher voltage stand offs. For example, an automotive application consistent with a nominal 12-volt system would require six ultracapacitors in series for a 15-volt stand off, which is necessary since voltages at that level are used for charging the battery, and it also provides design margin. As voltage requirements rise, a series configuration may not be the most economical approach. In some instances it makes sense to use a DC-to-DC converter, taking advantage of the boost characteristics of a switch mode power converter. In addition to the use of the many topologies available for power conversion using switch mode circuitry, a microprocessor controller may be necessary. For example, in a hybrid power source it is often desirable to disengage the ultracapacitor bank from the main power buss, or it may be desirable to monitor voltage levels on the buss and be able to disengage the capacitor bank in the event of a surge voltage on the buss to prevent damage to the capacitor bank. Obviously, the specific application will dictate the details of what is required.

Making ultracapacitors and designing integrated systems satisfies an automotive engineer's power needs. The techniques available today include the construction of an ultracapacitor matrix to achieve voltage stand off requirements (series string), overall required capacitance (parallel strings), the inclusion of switch mode circuitry for DC-DC, DC-AC, or other combinations, and the control circuitry, most of which is microcomputer based. Through evaluating ultracapacitor solutions, engineering teams can benefit from cost analysis and come up with the best solution for an electric vehicle. The use of switch mode devices and smart controllers extends the usefulness of ultracapacitors far beyond what most engineers are aware of in today's industry.

Chad Hall is the COO of Ioxus, Inc. Previously, he spent 14 years with Ioxus' parent company, Custom Electronics, Inc. (CEI). His extensive mechanical engineering and business experience helped establish Ioxus from funding to factory to launch.

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