

BATTERY POWER PRODUCTS & TECHNOLOGY

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

Saft Introduces Latest Lithium-Ion Technology with Optus D3 Communications Satellite Launch



The recent launch of the Optus D3 communications satellite marks the first flight of Saft's newest lithium-ion (Li-ion) technology. The VES 180 cells provide an additional 30 percent of energy (40 Wh), in the same package size, as the previous version (VES 140). Saft developed the VES 180 cell with the help of the European Space Agency and The Centre National d'Etudes Spatiales (CNES) to offer the highest energy and en-

ergy density cells available for space applications.

Built for Australia-based Optus Networks Pty Limited by Orbital Sciences Corp., the Optus D3 will provide Ku-band fixed communications and direct television broadcasting services to Australia and New Zealand.

The satellite is based on the flight-proven STAR bus and is among the most powerful GEO communications satellites ever built by Orbital, generating nearly 5.0 kilowatts of payload power. The satellite carries 24 active Ku-band transponders on a platform suited for telephony, data and broadcasting applications.

The rechargeable Li-Ion batteries will deliver satellite power during two eclipse seasons per year when the spacecraft is blocked from the sun, allowing Orbital to significantly decrease the satellite's weight.

This approximately 30 to 50 percent weight savings on the battery allows Orbital to produce a more powerful satellite by dedicating more of its crucial mass to the payload, or revenue generating part of the spacecraft.

Saft provided two Li-ion batteries with VES 180 cells in the 4P9S configuration, each delivering 50 Ah.

In addition to the Optus D3, Saft has provided batteries for several Orbital-built satellites, including the MEASAT-3a, which launched in June, and both the Optus D1 and Optus D2 satellites that launched in 2006 and 2007, respectively. Saft also supplied its Li-ion technology for Orbital's Horizons-2 and THOR 5 satellites, both launched in 2008. Orbital's KOREASAT 6 is currently being manufactured with Saft Li-ion batteries on-board and is scheduled for launch in 2010.



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NEMA Urges Compliance with Regulations, Opposes Proposal To Ban Lithium Batteries

The National Electrical Manufacturers Association (NEMA) called on US authorities to take full advantage of current safety regulations on air shipments of lithium batteries and cited as unnecessary a recent proposal by the airline pilots union to ban lithium batteries from being shipped as cargo on US passenger and cargo aircraft. NEMA cited the additional burden such a measure that would impose on battery users, consumers and industry.

Before it considers adding new requirements that have not been fully vetted, the Pipeline and Hazardous Materials Safety Administration (PHMSA) of the US Department of Transportation should proceed with its plan to propose updating the US regulations to account for changes made by international authorities since 2007, NEMA wrote in a letter to PHMSA.

According to Kyle Pitsor, NEMA vice president of Government Relations, the recent incidents cited by the pilots union appear to be instances of non-compliance with existing US regulations, not due to a lack of regulations.

NEMA's Dry Battery Section represents major manufacturers of portable primary batteries of many chemistries, including lithium. Military, aerospace, biomedical and consumer applications have been made possible, and even driven by, the development of lithium batteries. Non-rechargeable lithium metal batteries are produced in a wide variety of sizes, from coin cells to cylindrical batteries and are used in a wide variety of everyday items. They also serve as memory back-up in numerous consumer and critical safety applications. Lithium metal batteries are currently banned by US authorities as cargo on passenger aircraft.

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Single Cell Nicad/Nimh (Flat Top & Consumer Top)
The most complete line of single cells in the country!!!

Flat top cells for assembly

SUB-C SIZE	Cell Size	Capacity mAh	Size (inches)		Dantona PT#
			Dia	Hgt	
NIMH	1/2SC	700	0.906	1.02	1/2SC-700
	4/5SC	1300	0.906	1.34	4/5SC-1300 **
	SC	1500	0.906	1.69	SC-1500 **
					SC-1500CS **
		1900	0.906	1.69	SC-1900 **
		2100	0.906	1.69	SC-2100 **
		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-2000NM **
	SC	3300	0.906	1.69	SCR-3300NM **

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

AF SIZE	Cell Size	Capacity mAh	Size (inches)		Dantona PT#
			Dia	Hgt	
NIMH	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-600NM
	2/3AF	1100	0.67	1.1	2/3AF-1100NM-GP
	2100	0.67	1.69	4/5AF-2100NM-GP	
	4/5AF	2000	0.67	1.69	These cells replace Sanyo: HR-4/5AU
		2500	0.67	1.97	4/5AF-2500NM-GP
	AF	2700	0.67	1.97	These cells replace Sanyo: HR-AU
					AF-2700NM
	4/3A (17MM)	3800	0.67(17mm)	2.63	4/3AF-3800NM-GP
					These cells replace Sanyo: HR-4/3AU
	4/3A (18MM)	4500	0.67(18mm)	2.63	4/3AF-3800NM
				4/3AF-4500NM-GP	
4/3A (18MM)	4500	.71 (18mm)	2.63	4/3AF-4500NM-GP	
				These cells replace Sanyo: HR-4/3FAUX	
				4/3AF-4500NM	

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)		Dantona PT#
			Dia	Hgt	
NIMH	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-300NMF
	1/2AA	500	0.56	0.94	1/2AA-500NM-SHORT
	2/3AA	750	0.57	1.18	1/2AA-750NM-GP
	4/5AA	1200	0.57	1.65	4/5AA-1200NM
	AA	1600	0.55	1.97	AA-1600NMF
AA	1800	0.55	1.97	AA-1800NMF	
AA	2100	0.55	1.97	AA-2100NMF	
5/4AA	2200	0.55	2.64	5/4AA-2200NMF	

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)		Dantona PT#	
			Dia	Hgt		
NIMH	AAA	300	0.414	1.75	AAA-300FT	
	Gold Peak is the manufacturer of cells with "GP" in the part number.					
	1/4AAA	110	0.41	0.43	1/4AAA-110NM-GP	
	1/3AAA	170	0.41	0.56	1/3AAA-170NM-GP	
	1/2AAA	350	0.41	0.9	1/2AAA-350NM-GP	
	2/3AAA	400	0.41	1.15	2/3AAA-400NM	
	4/5AAA	500	0.41	1.43	4/5AAA-500NM-GP	
	AAA	750	0.41	1.72	AAA-750NMF	
	AAA	950	0.41	1.72	AAA-950NMF	
	5/4AAA	800	0.41	1.96	5/4AAA-800NM	

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

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

Flat top cells for assembly

PRISMATIC CELLS	Cell Size	Capacity mAh	Size (mm)		Dantona PT#
			Length / Width / Thick		
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 15 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)		Dantona PT#
			Dia	Hgt	
NIMH	1/2C	700	1.02	0.946	1/2C-700FT
	3/5C	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-4500NM

D SIZE	Cell Size	Capacity mAh	Size (inches)		Dantona PT#
			Dia	Hgt	
NIMH	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-5000NMF
	D	9000	1.34	2.4	D-9000NM

F SIZE	Cell Size	Capacity mAh	Size (inches)		Dantona PT#
			Dia	Hgt	
NIMH	4/3D (F)	7000	1.34	3.6	F-7000
	4/3D (F)	13000	1.34	3.6	F-13000NM

BUTTON CELLS	Cell Size	Capacity mAh	Size (inches)		Dantona PT#
			Dia	Hgt	
NIMH	30	30	0.46	0.21	30SS
	60	60	0.61	0.23	60SS
	280	280	0.98	0.33	280SS
	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)		Dantona Part No.
			Dia	Hgt	
NIMH	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-1600NM
	AA	1800	0.55	1.97	AA-1800NM
	AA	2100	0.55	1.97	AA-2100NM
	AA	2500	0.55	1.97	AA-2500NM

AAA SIZE	Cell Size	Capacity mAh	Size (inches)		Dantona Part No.	
			Dia	Hgt		
NIMH	AAA	350	0.414	1.75	AAA-350	
	When you think batteries, think DANTONA !!					
	AAA	750	0.414	1.75	AAA-750NM	
AAA	900	0.414	1.75	AAA-900NM		

C SIZE	Cell Size	Capacity mAh	Size (inches)		Dantona Part No.
			Dia	Hgt	
NIMH	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-4500NM

D SIZE	Cell Size	Capacity mAh	Size (inches)		Dantona Part No.
			Dia	Hgt	
NIMH	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-9000NM

9V SIZE	Cell Size	Capacity mAh	Size (inches)		Dantona Part No.	
			Dia	Hgt		
NIMH	9V	120	STANDARD 9V SIZE		9V-8.4NCD	
	Gold Peak is the manufacturer of packs with "GP" in the part number.					
	9V (9.6V)	170	STANDARD 9V SIZE		9V-9.6NMH-GP	
	9V (8.4V)	200	STANDARD 9V SIZE		9V-8.4NM-GP	
	9V (8.4V)	280	STANDARD 9V SIZE		9V-8.4NM-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

BPP&T

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From the Editor

There are some exciting changes on the horizon for Battery Power magazine. Starting with the January/February 2010 issue, we are changing our name to simply *Battery Power*, and we are changing our format from a tabloid sized publication to a standard size publication. The evolution of the magazine will still feature new products and technologies entering the market, but will also have expanded editorial coverage with more feature articles, application stories and guest columnists.

As always, the magazine is focused to help keep our readers stay abreast of the latest trends and developments in the battery industry.

So keep your eye out for the new size and look of Battery Power magazine!

Shannon Given
Director of Content

New Batteries on the Market

Imara Corp Launches Its First High-Power Lithium-Ion Battery Cell

Imara Corp., a manufacturer of high-performance next-generation lithium-ion batteries, has introduced high-power cells for the power tool, outdoor power equipment and transportation markets.

Imara's technology breaks through conventional battery technology barriers that require a trade off between fast power discharge and high energy density for extended run time.

Imara's technology enables a new class of green applications. An hour of use of a typical four-stroke gas-powered lawnmower replaced with Imara battery power eliminates the emissions equivalent to 11 SUV's driving on the highway for an hour. Replacing one two-stroke weed-whacker or leaf blower with Imara battery power is equivalent to taking 17 SUVs off the road.



Trojan Battery Announces the New T105-RE Renewable Energy Battery

Trojan Battery Company has introduced the T105-RE renewable energy battery. The existing RE series is built on deep cycle batteries to deliver improved life, durability and charge efficiency for renewable energy applications. The T105-RE battery is built on Trojan's 6-volt deep cycle battery, featuring a compact size, enhanced performance and five-year worldwide warranty.



The T105-RE features DuraGrid technology for an eight-year design life and charge efficiency, Maxguard XL Advanced Design Separator, which is 30 percent thicker and stronger, resists stratification, extends life and lowers overall maintenance costs.

Energizer's Rechargeable AA Battery Gets a Makeover

Energizer has introduced its Energizer Rechargeable AA battery. As a result of advances in rechargeable technology, Energizer has increased the capabilities of its AA rechargeable battery. Consumers will see the benefits in increased charge cycles and longer charge retention while holding capacity at a high rate.

The Rechargeable AA now can be charged up to 500 times, up to 150 more charging cycles than previous Energizer 2,450 mAh Rechargeable AA. The new battery will continue to last up to four times longer than Energizer Max batteries in digital

cameras, but now holds more charge at six months than previous Energizer Rechargeable AA. These improvements make the new Energizer Rechargeable AA battery well suited for high drain devices like digital cameras and also a good solution for use in low drain devices, such as remotes and flashlights.

PowerGenix Taps into Green Consumer Market With Eco-Friendly Batteries

PowerGenix, a developer and manufacturer of nontoxic, high performance Nickel-Zinc (NiZn) rechargeable batteries, has introduced its AA NiZn batteries. The batteries are the first to bare the PowerGenix brand name, and provide advanced performance and leading environmental credentials to satisfy green gadget users and eco-moms alike.

The limited performance capabilities of rechargeable AA batteries has historically hampered their market acceptance, as portable consumer electronic devices, such as cameras and flashlights, are designed for optimal use with more powerful disposable batteries. PowerGenix's Nickel-Zinc AA's are the first rechargeable to deliver power equivalent to primary, single-use batteries, a 30 percent increase compared to conventional AA rechargeable battery technologies.

In addition to offering advanced rechargeable battery performance, PowerGenix's NiZn batteries are also safe, non-combustible and nontoxic. Certified by independent third party testing to meet Reduction of Hazardous Substances (RoHS) standards, PowerGenix's batteries contain no heavy metals such as lead, cadmium or mercury.

PowerGenix's NiZn also represents the most recyclable rechargeable chemistry on the market and has received certification from the Rechargeable Battery Recycling Corp. (RBRC) for collection and recycling at its more than 30,000 drop-off points in North America.

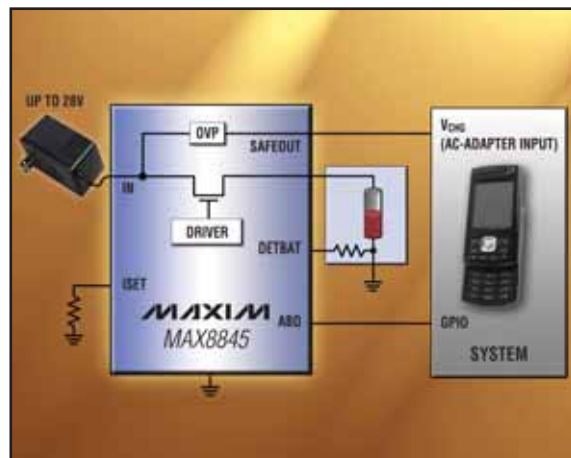


BatteryJack's PowerStar PS12-230

BatteryJack's sealed lead division, PowerStar, has developed an extreme performance, high drain deep cycle battery used in many back-up power and solar applications. The lead-calcium alloy plates inside ensures improved performance and longlife. The sealed, maintenance free technology keeps users from having to monitor water and acid levels, while allowing them to mount the battery in any position. The 12 V 230 AH battery measures at 20.55 inches by 9.45 inches by 8.58 inches and weighs 141 lbs. The PS12-230 is a green energy alternative to the hazardous wet-cell batteries.

Highly Flexible 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.

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. Additionally, all of the chargers feature an integrated pass transistor, which eliminates the need for an external FET, and reduces overall design cost, size and complexity.

With their unique combination of features and chemistry, the new chargers are well suited for devices in the consumer, medical and industrial markets.

Microchip also announced two evaluation boards to support the new chargers. The MCP73113 OVP single-cell Li-Ion battery charger evaluation board provides users with a platform to test the basic functionality of single-cell Li-Ion battery charging at 4.2 V, with 6.5 V overvoltage protection. The MCP73213 Evaluation Board enables users to test the basic functionality of a dual-cell Li-Ion battery charging at 8.4 V, with 13 V overvoltage protection.



Summit Introduces 10 Amp Synchronous DC/DC Controller With Digital Power Control

Summit Microelectronics has expanded its family of programmable power manager (PPM) integrated circuits (ICs) with the SMB211 single-channel, synchronous DC/DC controller. The SMB211 continues Summit's approach to power supply design by combining flexibility, features and performance with ease-of-use. With a serial digital interface, the SMB211 can be easily configured during development (on-board, non-volatile memory) and re-programmed in system by host software. The result is a high-performance digitally controlled power supply design that is easily customizable without tedious hardware design cycles or complex microcontroller-style software coding.



The SMB211 combines high-performance power conversion and digital control in a single, space-saving device. The integration of advanced power control functions eliminates external components and cost, improves functionality and performance and minimizes development time. Summit's non-volatile configurable technology enables the implementation

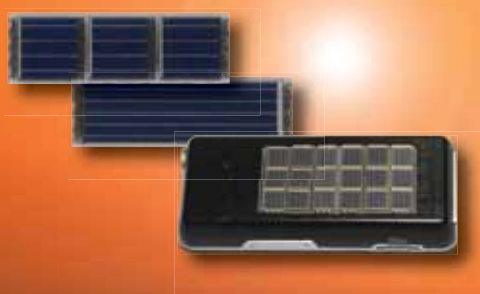
of flexible "platform solutions" that can be easily modified for different designs without any hardware changes.

The SMB211 integrates a synchronous DC-DC step-down (buck) converter with a useful set of digital control functions. The device's high current drive capability allows more than 10 A of output, while using a wide variety of industry-standard MOSFETs. The SMB211 can operate at four different, programmable frequencies (250 kHz, 500 kHz, 750 kHz and 1 MHz) allowing optimization of efficiency and component size. Soft-start and power-on delays are also selectable to address various system requirements, especially in multi-power supply applications.

The SMB211's output voltage accuracy is better than ± 1 percent and supports dynamic voltage scaling as well as margin high/low control via the serial digital interface. The output voltage can be digitally set from 0.5 V to 2.5 V in 10 mV steps, or from 1.0 V to 5.0 V in 20 mV steps. The output voltage is monitored for both over- and under-voltage conditions, thereby increasing system reliability. A configurable logic

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Integrated Circuits & Semiconductors

output that can be used as a RESET, POWER GOOD or SMBAlert output signal, is also available for notifying the system of out-of-regulation conditions. The device can operate in forced-PWM for noise-sensitive applications, as well as in automatic PWM/PFM mode for maximum light-load efficiency.

The SMB211 incorporates a pulse-by-pulse current limit by monitoring the voltage drop across the upper N-FET. Various current limit thresholds as well as several over-current response modes are available for maximum design flexibility. An Enable input allows the SMB211 to enter a low-power shutdown mode (less than 10 uA). A standby mode, via an I2C command, is also available for reducing current consumption while keeping the serial interface active. Additionally, the SMB211 provides complete power system diagnostics by digitally flagging a variety of fault conditions (output OVLO, output UVLO, IC temperature, over-current, input UVLO and others).

The SMB211 operates directly from an input voltage of 4.5 V to 13.5 V, however the external FETs can be powered from a lower voltage supply, as low as 3.3 V, if necessary. The rated operating temperature range is -30°C to 85°C. Programming is achieved via an industry-standard serial interface and configuration data is safely stored in non-volatile OTP memory.

The SMB211 is offered in a thermally-enhanced, lead-free 4 mm by 4 mm, 24-pad QFN. Available now in production quantities, the SMB211 is priced at \$0.66 each for the QFN package in quantities of 10,000 units.

Battery-Monitoring IC from STMicroelectronics Delivers High Accuracy and Extra Features for a Better Handheld Experience

STMicroelectronics has introduced a battery-condition monitoring IC enabling increased accuracy for fuel-gauge style indicators showing the operating time remaining. The device will improve the user experience for owners of products such as mobile handsets, portable navigation devices, digital cameras and personal media players.

The STC3100 battery-monitor IC can be located in the battery pack or in the handheld device, and integrates functions to monitor the battery voltage, current and temperature. It has a built-in Coulomb counter to calculate battery charge, and stores the data at 16-bit resolution for retrieval by the system controller. Access is via an industry-standard I2C interface, enabling the controller to create an accurate graphical representation of remaining battery-operating time.

The device supports extra functionality by providing one external pin for use as a

detector input or to drive an LED indicator. Each IC is also pre-programmed with a unique 64-bit identifier, which enables traceability of individual battery packs or sub-systems. In addition, 32 bytes of accessible RAM allow storage of battery history or application-related information throughout the lifetime of the battery.

There are also two package options, giving designers the choice of a small-outline MiniSO-8 leaded package or a 1 mm-high DFN8 leadless package with 3 mm by 3 mm overall footprint. The STC3100 is in mass production, and available at \$1.20 in quantities of 1,000 units.

Single-Chip Power Management Units for Portable Electronics Cut Board Space in Half

Texas Instruments, Inc. (TI) has introduced the TPS6507x family of single-chip, power management integrated circuits for portable electronics. The TPS65070 and TPS65073 devices result in a 50 percent smaller DC/DC implementation versus a discrete design by integrating three highly efficient, 2.25 MHz, 1.5 A DC/DC step-down converters that support core processor, memory and I/O voltages; two general purpose, 200 mA LDOs; white LED backlighting to support up to 5-inch LCD displays; I2C communications interface; 10-bit analog-to-digital converter; touch-screen interface and an integrated 1.5-A linear battery charger.

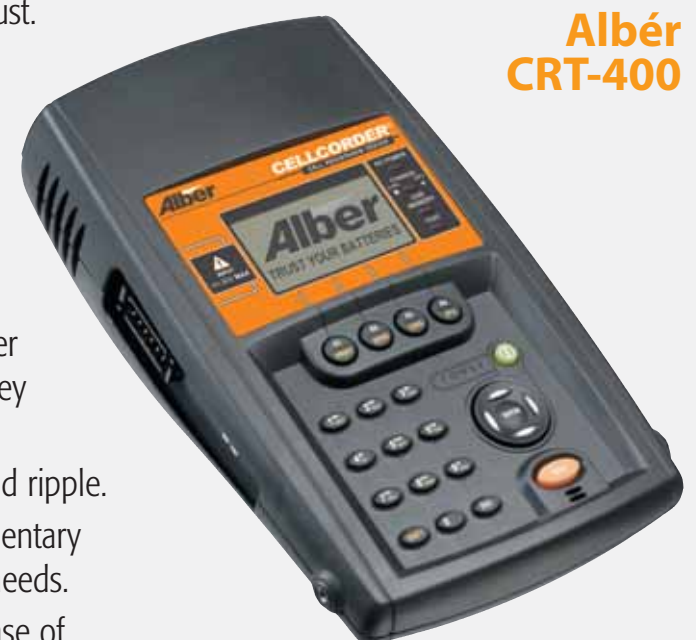
The TPS65070 and TPS65073 devices are available in volume production from TI and its authorized distributors. The devices come in a 6 mm by 6 mm by 0.4 mm, 48-pin, leadless, thermally enhanced QFN package with a suggested resale price of \$3.95 in 1,000-unit quantities.



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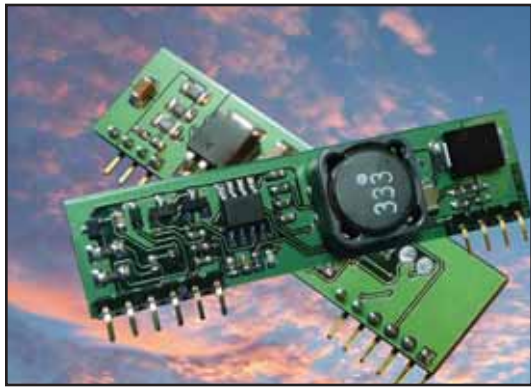
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Low Cost, Intelligent Battery Charger for Sealed Lead Acid Batteries



Aimed at developers of equipment with sealed lead acid (SLA) battery back-up, such as security, fire/safety and telecom/ datacom equipment, Silver Telecom has launched the first environmentally friendly SLA battery charger module capable of maximizing battery life and providing the user with a battery status output.

The challenge for equipment developers using SLA batteries has been providing the three-state charging necessary to achieve maximum

battery life. Three state charging requires providing constant-current bulk charge, constant voltage bulk charge and constant voltage trickle charge to the battery, depending on its charge state. Additional difficulties arise when battery temperature is taken

into account as this can alter the charging voltages applied to the battery.

The Ag102 module has the ability to detect battery condition and temperature and automatically provide the correct voltage levels and type of charge. This maximizes battery life, and provides the most efficient way of charging, with the added benefits of relaying battery status back to the user.

Packaged in a small footprint SIL module, Ag102 is a low cost solution that can also convey significant design time savings, as well as savings in PCB real estate. Designed and manufactured in the UK, and fully RoHS and WEEE compliant, the Ag102 supplements Silver Telecom's extensive range of power, datacom and telecom products.

Micro Power Introduces SMC-65 Battery Charger Module

Micro Power, has announced a SMC-65 battery charger module for Li-Ion batteries. The module is an open frame charger assembly that provides efficient, reliable battery charging in a small footprint that can be easily integrated into industrial, medical and military OEM products.

The SMC-65 module operates from a wide range DC input, so it can be used in desktop (via an external AC/DC converter), mobile automotive and military vehicular applications. It will safely charge most popular battery types and pack voltages (up to

19 volts). The 65 watt module has two battery interface configurations; digital (for smart batteries) and analog (batteries with no communications).

The SMC-65 module utilizes a programmable microprocessor charge control system with algorithms capable of charging Li-ion battery packs with or without fuel gauges. The SMC-65 module supports SMBus communications (SBS Level III) and can optionally accommodate DQ and HDQ communication protocols. Other features include variable rate charging and input/output reverse polarity protection.

Power Integrations Supports Smart-Grid Metering Engineers with New Technical Microsite and Reference Designs

Power Integrations has launched a new technical microsite, www.powerint.com/smartmeters, focusing on energy-efficient power supply solutions for utility meters used in smart-grid energy networks.

Utility companies are investing in the so-called smart grid as a way of monitoring, controlling, and managing electric power consumption in homes and businesses. The smart grid requires advanced metering solutions that can communicate with both the power company and the consumer, providing real-time information on energy use and cost. Smart meters help balance energy demand by allowing the supplier to implement incentive programs, such as variable pricing based on peak network loading. Utilities are also installing innovative network-connected devices that manage end-user power consumption. Customers are given pricing concessions in exchange for granting the supplier control of certain non-critical circuits.

According to Silvestro Fimiani, product marketing manager at Power Integrations, "A reliable, high-efficiency power supply is absolutely essential for supporting the net-



working and control electronics used in smart meters and control equipment. Our new microsite delivers several power supply solutions that are ideal for the next generation of smart meters. For example, using our LinkSwitch-CV primary-side control IC, designers can eliminate unreliable optocouplers from their power supplies and minimize the number of components required.

Power Integrations' Design Idea DER-213 describes a supply that delivers both 5-volt and 12-volt outputs from a universal 85- to 265-volt input, with high efficiency and conducted EMI meeting CISPR22B/EN55022B specifications."

DER-213 describes a supply that delivers both 5-volt and 12-volt outputs from a universal 85- to 265-volt input, with high efficiency and conducted EMI meeting CISPR22B/EN55022B specifications."

Atmel Launches Safe Battery Management Solution for Automotive and Industrial High-Cell-Count Li-Ion Battery Packs


Atmel Corp. has released the availability of a new Li-Ion battery management chipset for high-cell-count automotive and industrial applications such as electrical/hybrid vehicles, e-bikes or uninterruptible power supplies. Atmel is currently the only supplier to provide a complete two-chip protection solution including all necessary functionalities with the highest safety level.

The ATA6870/71 chipset requires less external components than comparable solutions because it includes a hot plug-in capability, six integrated AD converters with a cut-off frequency lower than 30 Hz, saving external filters and a stackable microcontroller power supply. With Atmel's cost-efficient 30-V CMOS technology, these features allow cost savings of up to 60 percent, compared to existing solutions.

The ATA6870 is the industry's first battery management IC to include all functionalities required to control a high-cell-count Li-Ion battery including six precise 12-bit AD converters for voltage monitoring, cell balancing, cell temperature measuring, and unique features such as stackable integrated power supply for a microcontroller or hot plug-in capability.

Since Li-Ion batteries are very sensitive against overcharging and deep discharge, they may burn or explode. To prevent this, Atmel provides a special safety strategy with its secondary protection device, the ATA6871. This monitors the battery cells' voltage and temperature and prevents Li-Ion batteries from thermal runaway or exploding. If either of these were to occur in a battery cell, it can then be switched off by the emergency relays.

Webcom's 2009 Worldwide Battery Industry Directory



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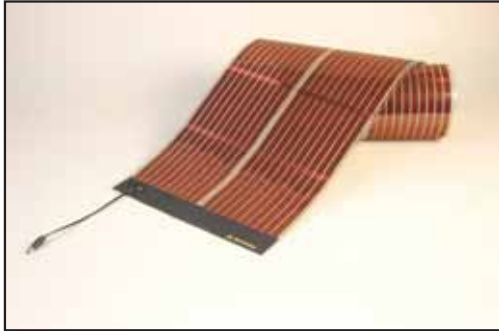
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Charging & Testing

Konarka Announces Solar Panels for Portable Charging Applications

Konarka Technologies, Inc. has unveiled a line of solar panels for use in a variety of portable charging applications that will be available worldwide in the fourth quarter of this year. Commercial products incorporating Konarka Power Plastic 20 series material, which include battery chargers for lighting, mobile phones and devices, carry bags and café umbrellas, will be available through the company's qualified resellers and partners program.



The Konarka Power Plastic 20 series includes the Power Plastic 120 (1-watt), Power Plastic 320 (3-watt) and Power Plastic 620 (7-watt) products. The panels vary in size and are available with and without integrated connectors, ready to be used or integrated into a manufacturer's device or product.

These solar panels are being made available for delivery in the fourth quarter of this year. Next year, the company will increase its portfolio with additional products for both higher and lower voltage applications.

Philadelphia Scientific Introduces TwinCharge Battery Charger Sequencer

Philadelphia Scientific has introduced TwinCharge, a battery charger sequencer that allows two industrial batteries to be charged sequentially from the same charger. TwinCharge enables warehouses and distribution centers to maximize battery charging capability, particularly when battery room charger slots are limited. This is often a problem, for example, when rental trucks are being used or a facility is being expanded. The new battery charger sequencer also provides significant savings for companies that may be considering the purchase of SCR or high frequency chargers, as the addition of a TwinCharge sequencer may be more cost effective than the purchase of a second SCR or high frequency charger.

When two batteries are plugged into TwinCharge's two output cables, one battery

automatically starts to charge. When the charge is completed, the first battery is safely isolated from the charger, preventing potential sparks during disconnection. The TwinCharge sequencer then automatically switches over and begins charging the second battery without operator input. The status of each battery is clearly displayed on the control panel as "connected," "charging" or "ready." The TwinCharge sequencer is powered from the battery that is being charged, so no additional A/C lines are required to power it.

The TwinCharge sequencer is also compliant with the Philadelphia Scientific Intelligent Battery Organizing System (iBOS) and comes ready to be connected to an iBOS system if desired. The sequencer can be connected to an existing or newly installed iBOS system so that each battery is individually monitored and will be dispatched in the order that its charge is completed.



Automotive Battery Chargers, Battery Maintainers and Battery Testers

Granite Digital has introduced its new line of Save A Battery 12 volt chargers, maintainers and testers. Designed to support all lead acid, AGM and Gel Cell batteries, they not only charge and maintain automotive type batteries but they also test, monitor, audible alarm, rejuvenate, condition, power cycle and diagnose electrical and charging systems. The built-in digital LCD display works as a voltmeter to pinpoint most electrical and charging system problems.

The Modular Cable System (supplied with all models) offers versatile connection styles including battery terminal, battery clip-on and cigarette lighter connections in both short or long cable lengths. Gold contacts are used to provide better conductivity in harsh garage and shop environments. All cable ends have a simple attaching loop that makes it easy to permanently fasten them to just about anything and moisture covers to keep the contacts clean.

A unique mounting system allows the chargers, maintainers and testers to be mounted on a wall or in a vehicle. The units can be removed and used remotely and then slipped back on the mounting bracket for long-term monitoring and maintaining.

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Rugged, 1/3 N Lithium Battery Holders

Keystone Electronics Corp. has introduced a new selection of rugged 1/3 N lithium battery holders for surface or through-hole mounting. These battery holders are supplied with durable, heat resistant, UL 94V-0 rated Nylon housings well suited for all soldering and reflow operations. The SMT version features Gold-Plated Phosphor Bronze contacts. The THM version incorporates Tin-Plated Phosphor Bronze contacts and the heat resistant Nylon housings. The THM types mount directly on PCB's, securely positioned during wave soldering and placement.

Both holders accept 1/3N 3-volt cell Lithium batteries from major manufacturers and are part of the company's continuing growth selection of battery hardware specialties including contacts, holders, retainers and straps in a variety of materials for coin cell, button cell and cylindrical batteries.

Ioxus Launches Ultracapacitors with High Power Densities for Military, Transportation and Alternative Energy Industries

Ioxus, Inc., developer, manufacturer and commercializer of innovative ultracapacitor technologies for a wide range of energy storage markets, has launched its first family of electric double layer capacitors (EDLCs) and power modules for military, transportation and alternative energy applications. Ioxus' family of ultracapacitors provides smaller-sized solutions with more capacitance and greater power densities over competitors.

Ioxus' ultracapacitors provide energy storage to improve the efficiency of hybrid electric vehicles by recycling the energy captured during braking and lowering peak power requirements on hybrid-diesel, fuel cell or battery-based vehicles. By stabilizing the power output of these systems with ultracapacitors, fuel-cell and battery-based applications realize significant increases in life cycles. When used in combination with batteries or other energy sources, Ioxus EDLCs reduce power drain from the energy source and extend its available life up to 400 percent.

Li-Ion 18650 Battery Holders

MPD has introduced its new line of Lithium Ion battery holders for 18650 protected cells. These holders accept from one to four 3.7 volt batteries and are suitable for consumer or industrial products. First on the market is part number, BK-18650-PC2, it accepts one of the new Li-Ion rechargeable batteries with built in circuit protection.

BK-18650-PC2 has large nickel plated stainless steel pressure contacts with pc pins tails that are 1.5 mm wide. While offering low resistance and by keeping a keep a tight connection with the cell by design your assured of a long term trouble free connection.

The UL94V-0 plastic body is light in weight yet combined with high strength for a long service life under natural conditions found in electronic equipment. The holder size is 77 long by 21 wide and under 22 mm high. The holder has two mounting holes for hard mounting or it can be bonded down with adhesive or double sided tapes.

Built in circuit protection eliminates the drawbacks associated with standard Li-Ion 18650 batteries. Standard 18650 cells are only supplied to manufacturers of battery packs because of concerns that batteries could overheat, potentially causing burns, an explosion or a fire. Protected 18650 cells have 2,400 to 3,000 mAh and are available

from several well known companies. List price for 1,000 pieces is \$1.57 each and volume discounts are available.

Compact Electronic Unit Prolongs Battery Life in All Vehicles

Cole Hersee has introduced its SureStart low voltage disconnect (LVD) switch 48513. The Cole Hersee SureStart low voltage disconnect switch electronically senses battery voltage and conserves starting power by disconnecting non-critical loads, prolonging battery life by preventing battery damage due to excessive discharge.

This switch is well suited for utility and delivery vehicles, as well as vehicles with ancillary on-board equipment, such as snowplows, hoists, pumps and floodlights, as well as in-cab amenities such as A/C. When battery drain occurs, there are substantial costs associated with downtime, vehicle recovery, and battery damage due to over-discharge. These costs can be eliminated when a Cole Hersee's SureStart LVD switch is used.

The switch has a rating of 100 A at 12 V or 24 VDC. Its service life exceeds 1,000,000 on/off cycles, and it also features a manual override that allows users to connect or disconnect the switch when needed, regardless of voltage.

The SureStart LVD switch features a compact size (4.5 inches by 4 inches by 4.27 inches), which makes it easy to install into a new or old vehicle. Unlike many voltage monitoring devices, the SureStart LVD switch does not require a separate solenoid to control high current, increasing reliability and simplifying installation. The switch's resistance to moisture, salt spray, vibration and shock make it a versatile device that can be implemented into any vehicle or environment.



Pressurex Pressure Indicating Sensor Film Minimizes Defects And Improves Quality in Battery Lamination

Pressurexfilm, from Sensor Products, Inc., is an economical, accurate and easy-to-use tool that reveals the distribution and magnitude of surface contact pressure in battery lamination and calendaring presses. Difficult to detect pressure variations across the surface of battery laminators and calendar presses can be easily detected and corrected through use of the sensor film.

When placed between lamination platens or calendar rolls, Pressurex instantaneously and permanently changes color directly proportional to the actual pressure applied. Precise pressure magnitude is then easily determined by comparing the resultant color intensity to a standardized color correlation chart (conceptually similar to using Litmus paper). No training or instrumentation is required.

Pressurex helps to ensure uniform alignment of mating rollers and lamination platens. If the contacting rollers and platens are not parallel, uneven compression could result in delamination during battery discharge or poor contact between the electrodes and their current collectors. Electrodes could also have uneven thicknesses reducing

contact area, which is a major problem for cylindrical Li-Ion and Li/MnO₂ cells and prismatic cells. In addition, uneven contact in heat seal presses could cause leakages in pouch cells.

During calendaring operations, positive and negative electrodes for Li-Ion cells and the MnO₂ electrode in Li/MnO₂ cells are densified using calendaring equipment. The electrodes are passed through heavy calender rollers in a continuous process.

Pressurex measures pressures from 2 to 43,200 PSI (0.14 to 3,000 kg/cm²). The pressure-indicating film is very thin (4 mil or 8 mil thick) and can be hand or laser-cut to any size or dimension. It is flexible and conforms to curved surfaces and invasive intolerant environments.

The film is coated on a Mylar sheet and is physically similar to a standard sheet of paper. Pressurex is available in eight pressure ranges.

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Power Supplies

New 100 Amp Three-Phase DIN Rail Power Supply

Automation Systems Interconnect, Inc. has introduced the newest addition to their line of power supplies, the 100 amp Three Phase Switching power supply. This compact power supply features "universal auto-ranging input," which means that the same part can be used with 340 to 550 VAC and provide a 24 VDC output. This new power supply is designed for use in SELV and PELV circuitry.

Additional features such as front panel LED status indication, adjustable output, and 100 percent factory tested make this ASI power supply well suited for industrial control applications.



DC/DC Converters for Medical Equipment

MEGA M1WG(H) and M2WG(H) series of 1 W and 2W DC/DC converters are designed to provide a 6 kV isolation barrier between input and output circuits, making them well suited for all medical and dental instruments that come into patient contact. The converters are tested for one minute, which equates to a rating of 7.5 kV if tested at one second, which is the lesser and more common test standard. Some models carry UL listings.



XP Power Introduces 250 Watt AC/DC Power Supply to Hit 95 Percent Efficiency

XP Power has announced a new 250 W AC/DC power supply, the CCM250, which achieves up to 95 percent efficiency, dramatically cutting the heat generated in medical, IT and industrial systems. Rival products typically operate at 90 percent maximum efficiency, with 10 percent of the input energy being converted to waste heat that needs to be removed. The 5 percent improvement in efficiency offered by the CCM250 means that it dissipates only half the heat, reducing or eliminating the requirement for heatsinks, or fans for forced-air cooling.

Removing the need for fans greatly increases reliability while reducing cost, audible noise, system complexity and size. Avoiding audible noise is particularly important in medical applications, where it disturbs patients. Both conducted and radiated emissions are below Class B limits as defined by EN55011, another important consideration in achieving type approval for medical equipment.

The power supply delivers full output with convection cooling over input voltages from 90 to 275 VAC, and 200 watts from 80 VAC, in ambient temperatures of -10°C to 50°C. It measures 6 inches by 4 inches by 1.54 inches, making it well suited for fitting in 1U enclosures. Where short-term peak power is needed, for example in motor start-up, the power supply will deliver up to 300 W for 500 ms.

The units have a full feature set for controlling the supply and external monitoring and control equipment. This includes a 5 V standby rail, remote on/off switching and power fail signals.

The design of the CCM250 combines conventional and novel design techniques to achieve a step-function in power density and efficiency. A three-stage converter using an interleaved, resonant, half-bridge, means that two relatively small transformers can replace one large one, saving board space. A zero current, virtually lossless switching topology for the main converter ensures high efficiency over a wide load range and contributes to exceptional EMI performance. A crystal-controlled clock and digitally generated drive signals are used to ensure accurate, fixed-frequency timing for switching transistors. The power supply's footprint is minimized through innovative mechanical construction. Heat-generating parts are bonded directly to the U-channel chassis, and magnetic components are conduction-cooled, enabling the use of smaller parts.

The CCM250 is available in sample quantities now, priced from \$195 each in OEM quantities from Newark or direct from XP Power.

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Thin Printed Carbon-Zinc Batteries Galvanizing Portable, "Green" Product Development

Matt Ream, Marketing Manager
Blue Spark Technologies

According to industry analysts, the commercialization of printed electronics is projected to revolutionize major segments of the portable electronics industry. Printed electronics describe the printing of electronic devices on common media, such as paper, plastic or textiles, using traditional printing processes. Devices now being produced in this way are programmable chips/integrated circuits (ICs), RFID antennas and tags, printed displays and thin printed batteries, which provide a low-voltage, eco-friendly power source to activate the device's functionality.

Industry analyst IDTechEx forecasts the market potential for printed electronics will be more than \$35 billion by 2018. NanoMarkets predicts that sales of thin film and printed batteries will exceed \$5 billion by 2015.

The growth of printed electronics is being driven by leading developers and integrators who are forming alliances to exploit the technology's unique capabilities to create products and systems that generate business value. We are already starting to see exciting innovations in printed electronics in the industrial, financial, security, food, pharmaceutical, healthcare and consumer markets.

The Role of Thin Printed Batteries

At the heart of many of these new products are thin, flexible printed carbon-zinc batteries that function as primary battery cells. They are not rechargeable; however, they are relatively low in cost and offer a broad range of capabilities. Batteries may be safely stored in cold storage to slow the chemical reaction in the battery, extending its shelf life. Power generation in the battery results from a chemical reaction between the electrolyte liquid and other materials.

Most standard printed carbon-zinc batteries generate 1.5 volts and are capable of delivering peak drain currents of at least 1 mA.

Voltages above 1.5 V can be supplied by integrating multiple 1.5 V cells in series into a single package. Depending on the application, customizable versions can also be designed.

With conventional printing, production is faster and less costly, so new designs can be prototyped quickly and economically. Additional advantages of printed batteries over traditional button or coin cells include:

- **Thin, Flexible, Form Factor:** Thickness profiles ranging from 700 microns (0.027 inch) to ultra-thin 500 microns (0.020 inch) allow printed batteries to share a thin, flexible substrate with other small form factor electronics. This helps to streamline assembly and reduces the time and cost of integrating "smart electronics" into new products.
- **Eco-Friendly, Safely Disposable:** Unlike batteries containing lithium, mercury and other battery chemistries, carbon-zinc batteries are completely "green." They are lead-free and contain no toxic substances, fully meeting the European Union's Restrictions on Hazardous Substances (RoHS) Directive and are safely disposable. This is important as global environmental regulations become more and more stringent.

Applications are Growing

As awareness and adoption of printed electronics and printed batteries continues to expand worldwide, the number and diversity of applications continues to increase. Following is a sampling of product applications in which thin printed, low-voltage carbon-zinc batteries are being tested and deployed.

Battery-Assisted Passive RFID

Industry analysts agree that RFID delivers business value and is here to stay. Closed-loop RFID systems have proven exceptionally valuable in asset management, inventory control, product and people tracking and disaster and event management. VDC

Research Group recently predicted that RFID revenues in 2009 are on track to grow nearly 10 percent over 2008 levels.

Aiding this growth is battery-assisted passive (BAP) RFID, sometimes termed semi-passive. BAP RFID can extend read ranges and improve RFID tag readability, especially in applications involving RFID-unfriendly materials, such as liquids and metals or applications in which individual tagged items are densely packed or stacked. Well-designed BAP RFID systems can also provide extended memory capabilities, as well as increased security and data protection.

BAP RFID is proving valuable in numerous applications because it can significantly extend the capabilities of passive RFID at a fraction of the cost and complexity required to implement high-end active RFID and real-time location systems. Battery-assisted passive RFID applications and benefits include:

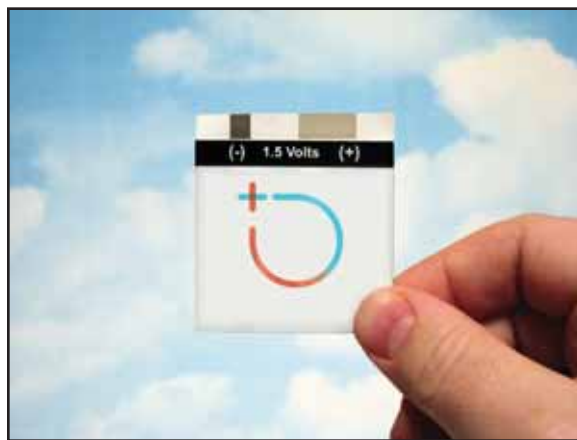
- Asset tracking of goods, materials or work-in-process in manufacturing plants, warehouses and distribution centers to improve accuracy, streamline workflow and reduce costs by increasing visibility and minimizing waste.
- Inventory management in warehouses and distribution centers, which eliminates the need to perform time and labor intensive physical counts.
- Stock and inventory management in retail stores through the use of "smart shelf" or "smart case" systems, which provides instant visibility of stock on hand, minimizes overstocks and out-of-stocks.

RF-Linked Sensor and Data Logging Systems

Radio frequency-enabled time and temperature monitoring systems are becoming increasingly popular in the food industry as a way to ensure consumer safety, maintain quality control and reduce waste. Meat, poultry, seafood, produce, dairy and frozen food processors and distributors can derive measurable value from such systems.

Sealed Air Corp. designed its TurboTag RFID time and temperature monitoring system that uses a sensor probe and battery-powered "smart" card to ensure cold chain compliance. The system uses Blue Spark ST printed batteries to support the silicon chip's data logging functionality. The portable TurboTag system is being used to track temperatures across the entire supply chain, from point of origin to points of delivery.

RFID sensor systems are also useful for shippers and distributors of temperature-sensitive pharmaceuticals, biologicals and chemical products. The pharmaceutical industry is taking a closer look at temperature data loggers as an increasing number of new drugs being developed require strict temperature control to maintain their efficacy.



Blue Spark Technologies' customizable 1.5-volt carbon-zinc batteries provide a reliable, eco-friendly power source for numerous applications. The company's battery technology is built on patented intellectual property acquired from the Eveready Battery Company (now Energizer).



Sealed Air Corp.' TurboTag RFID time and temperature monitoring system uses an RF-enabled sensor device and battery-powered "smart" card to ensure food and beverage cold chain compliance.

Other types of sensor systems could be designed to monitor ambient humidity, shock or vibration. In all of these applications, standard low-voltage, carbon-zinc batteries can be embedded within a "smart card" or smart label form factor to provide the power boost required for time-phased monitoring and autonomous data logging systems. The value proposition of real-time sensor systems is high because they offer portability, accuracy and ease of operation while providing important information.

Smart Packaging, Retail Display Merchandisers

Printed carbon-zinc batteries are well suited to a wide range of smart packaging applications and point-of-purchase merchandising displays because the batteries and other electronics can often be printed simultaneously with the packages or displays. According to NanoMarkets, a Virginia-based industry analyst, some niche applications for battery-powered smart packaging may include pharmaceutical compliance packaging, case and pallet freshness monitoring devices, and tamper-proof courier packages. Printed batteries can also be used to power an LED or voice activation device in interactive store merchandisers to drive sales and increase profits by engaging consumer attention.

Powered or "Smart" Cards

There are an estimated four billion or "smart cards", cards containing ICs or chips, being shipped annually worldwide. Trends driving this growth are an urgent need for increased security and authentication, as well as the growing popularity of contactless payments and consumer preference for wallet-size cards integrating interactive innovations. Battery-powered cards can incorporate lighted or color-changing displays, stored value and account status information, authentication codes, and other interactive functions. Powered card applications include:

- One-time password (OTP) cards for secure Internet credit transaction, access to brokerage accounts, monetary wires, IT and other high-value security assets
- Contactless credit and debit cards
- Stored value gift cards and municipal transit cards
- Organization membership and retail loyalty cards
- Secure identification cards and badges for access control in buildings or at events

Transdermal Patches

The medical device, healthcare and cosmetics/skincare markets are already developing and launching products using thin printed batteries in the design and manufacture of iontophoretic (i.e., transdermal) patches, which can be applied directly onto the skin. The fact that printed batteries can be customized relative to size and shape makes them particularly attractive for this. The role of the battery in patch applications is to actively drive the patch's ingredients through the dermal layer of the skin. Batteries may also be used to regulate consistent dosage of the patch's active ingredient(s). Applications include:

- Cosmetic aids (e.g., wrinkle removers and other skin care treatments)
- Self-administered drug delivery (e.g. nicotine patches, pain relievers)
- Therapeutic wound care for humans and pets

Interactive Printed Media and Consumer Products

Another potentially profitable market is high-volume consumer novelties. Products such as musical and self-recorded greeting cards, and interactive printed media, such as books, posters, games and trading cards, can be programmed to interact with consumers via sight, sound and touch. While the cost of manufacturing is a significant factor for producers of these items, their mass market potential can number in the billions, making this impulse-driven consumer market a very attractive target for printed electronics and thin printed batteries.

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Printed electronics and thin printed batteries have enormous potential to spark the creation of a host of dynamic new products for the industrial, consumer, financial, security and healthcare markets.

As we move forward, this remarkable technology is expected to energize OEMs and electronic system designers, not only to create new products, but also to simplify existing product designs and improve their manufacturing cost structure. While still in early days, the printed electronics "revolution" is revving up to help companies streamline product design, prototyping, production and integration, so they can bring products to market faster and at lower cost than ever before.

Matt Ream is marketing manager for Blue Spark Technologies, a developer of flexible, eco-friendly proprietary power source solutions for battery-powered printed electronic systems. As an electronics engineer, Ream has twenty years of experience in high tech electronics and radio frequency identification (RFID) and has held senior positions in engineering, product research and development and marketing.

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Advancements in Water-Based Processing for Large Format Lithium Ion Cells

Jacob Muthu, PhD, VP, Research & Development
 John Battaglini, VP, Applications Development
 International Battery, Inc.

The performance, cost and safety of batteries can very often make or break an application. Nowhere is this more true than in the transportation and stationary power markets. As electric vehicles and the smart grid transform their respective industries, the role and significance of Lithium-Ion batteries continues to increase. Hybrid electric vehicles (HEV), plug-in hybrid electric vehicles (PHEV) and electric vehicles (EV) are increasingly turning to Li-Ion batteries for their next generation vehicles. In the utility industry, battery-based energy storage is being deployed throughout the grid ranging from MWhr trailer systems for frequency regulation to 50 to 100 KWh systems for community energy storage.

Historically, the science underlying the battery technology has often been criticized for its slow growth when compared with Moore's Law in the semiconductor industry and rapid innovation in the computer industry. Recently, advancements in Li-Ion technology have brought considerable improvement in energy and power performance to meet the demand of next generation vehicles and utility smart grid applications. However, the widespread adoption of Li-Ion batteries in commercial vehicles is still limited because of its cost and inherent safety. As such, research and development efforts are continuing to reduce Li-Ion battery costs by introducing alternative materials and processes. A significant advancement has been made with water-based processing aimed at reducing battery costs and protecting the environment at the same time.

Manufacturing Alternatives

Li-Ion cells consist of a positive and negative electrode separated by an electrolyte solution. The electrodes consist of active materials, a binder (predominantly PVdF) and additives that enhance the electronic conductivity of the active materials. Traditionally, Li-Ion electrodes are made using a slurry-based process that uses large amounts of organic solvents to homogeneously mix the components mentioned above. The solvent predominantly used in the Li-Ion industry is N-Methylpyrrolidone (NMP). However, the use of organic solvents is undesirable because of the high cost associated with environmentally compliant handling and disposal, the added material and capital cost for the manufacturing process and the toxicity of the solvent.



Figure 1. Open Air Water-Based Coating Process Equipment



Figure 2.

The additional manufacturing costs and environmental concerns associated with the solvent-based process may limit the potential to drive the manufacturing cost down to the level required for widespread adoption in many applications. At International Battery, the focus is on manufacturing Li-Ion cells using a water soluble binder (WSB) based process for both the cathode and anode. By eliminating the solvent from the manufacturing process, the material cost and capital investment cost can be reduced considerably. The WSB process has shown not to add any material cost to manufacturing and water is abundantly available. The WSB process uses water as a medium to dissolve and disperse the binders and the electrode materials respectively (Figure 1). For the solvent-based process, additional recovery equipment, hoods and precautions are necessary.

A recent analysis performed by International Battery compared the capital costs, operating costs and environmental factors for building and operating a battery manufacturing facility. One scenario involved energy based applications (1 MWh bulk storage for utilities) and assumed usage of large format 160 Ah Lithium Iron Phosphate (LFP) cells (Figure 2). The other scenario involved hybrid vehicle applications using a "smaller" cell in the 40 to 60 Ahr range.

The results of the energy scenario are summarized. Compared to a traditional solvent-based process, the water-based process resulted in the following advantages:

- 10 percent reduction in capital costs
- 85 percent reduction in waste management expenses

- 65 percent reduction in solvent costs
- 10 percent reduction in cost per Whr

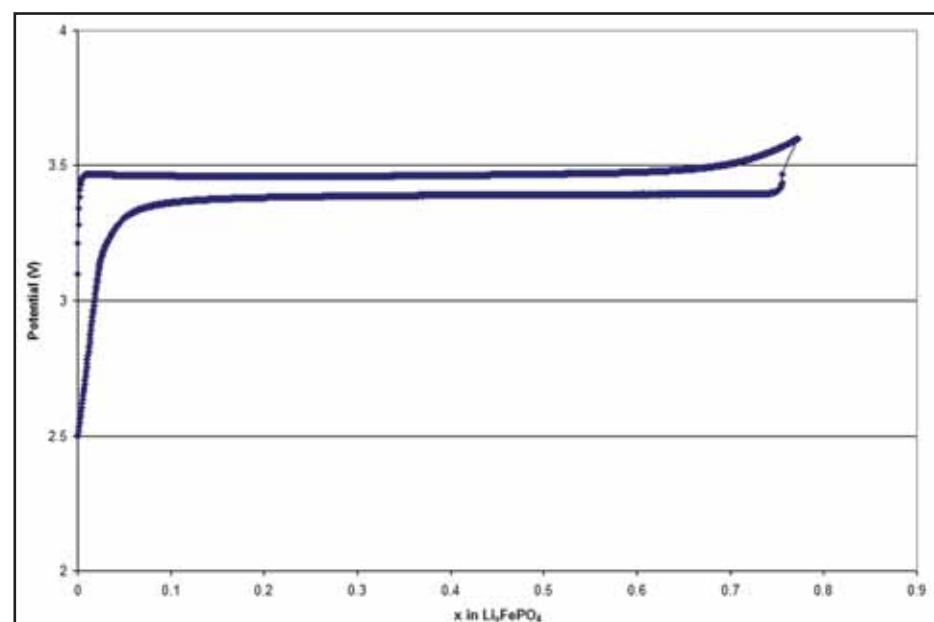
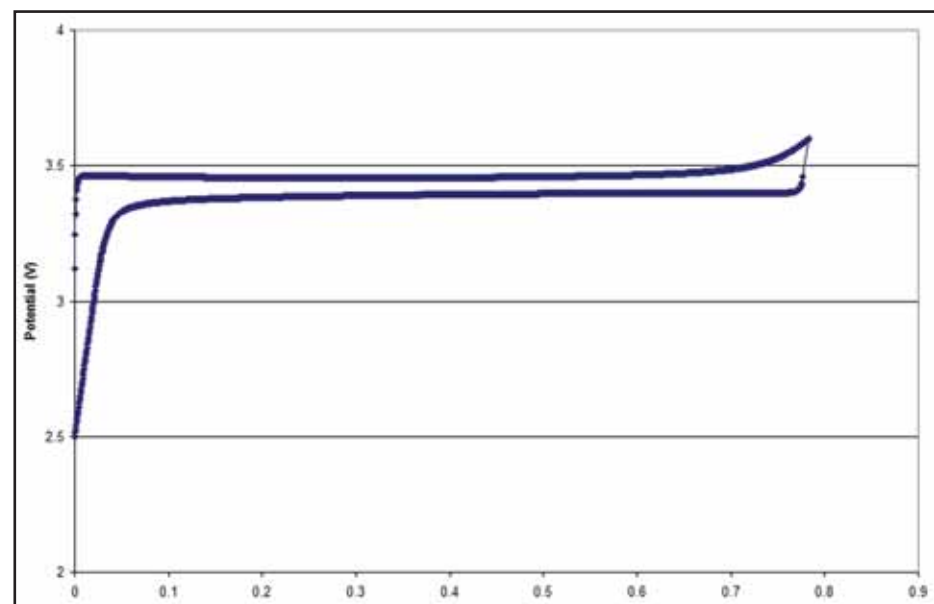
Additionally, building a facility with a water-based process results in:

- A radical reduction in volatile organic compound (VOC) emissions
- Lower energy consumption
- Easier siting and permitting

Performance Comparisons

It is well known in the battery industry that water and Li-Ion cells do not like each other. As such, there is a perception that a WSB process may potentially limit the performance of the Li-Ion cell's cycle life, shelf life and power performance. Several research studies have been published about the satisfactory switch from a solvent-based process to a water-based process for the graphite anode. However, very limited information is available about the cathode materials used in the Li-Ion industry. Research and development work at International Battery has focused on addressing the stability of the cathode materials in an aqueous media. LiFePO_4 has a tendency to absorb moisture while stored at ambient temperature. K. Zaghib et al. reported that LiFePO_4 stored at 25°C, 50 percent humidity, the capacity fade is significant and it is not reversible.

To address the stability of the LiFePO_4 cathode in a WSB process, electrodes were made using a LiFePO_4 cathode and a graphite anode using a WSB binder (proprietary binder). Electrodes were also made with a PVdF binder with NMP solvent. Lithium half-cells were built for LiFePO_4 cathode made using the WSB process and the solvent-based process. The electrodes were thick for both WSB and PVdF electrodes. The lithium half-cells were cycled at C/26 rate to test for capacity. The cells with the water soluble binder and PVdF based solvent binder delivered similar capacity. The WSB electrode had a first charge capacity of 140 mAh/g and a first discharge capacity of 125 mAh/g. The solvent-based electrode had a first charge capacity of 137 mAh/g and a



Figures 3A and 3B. Second cycle charge/discharge curves for (A) WSB process and (B) PVdF solvent-based process. The charge/discharge curve is for the second cycle. The cells were charged and discharged at C/26 rate for capacity determination. Cell configuration (Lithium metal/electrolyte/ LiFePO_4 cathode)

first discharge capacity of 123 mAh/g. Cells were charged to 3.6 V at C/26 rate constant current charging and allowed to rest for 20 minutes before discharge. The cells did not go through constant voltage charge. There was no difference between the water-based process and solvent-based process. The WSB cells and solvent-based cells specific discharge capacity show minimal increase during second cycle (Figure 3, A and B). The capacity trend for thick electrodes matches well with the earlier results reported in the literature for the water soluble binder and PVdF solvent binder electrodes.

The charge discharge curves for WSB process and solvent process are shown in Figure 3. Figure 3 shows that there is no additional electrochemical contribution except for the theoretical voltage plateau of the $\text{LiFePO}_4/\text{FePO}_4$ redox couple. Large format cells were made using the WSB process and the capacity of the cell is around 160 Ah. The cells were cycled at C/3 rate at room temperature (Figure 4). The cells were cycled for about 520 cycles and the cells show very minimal capacity fade (Cycle life tests are continu-

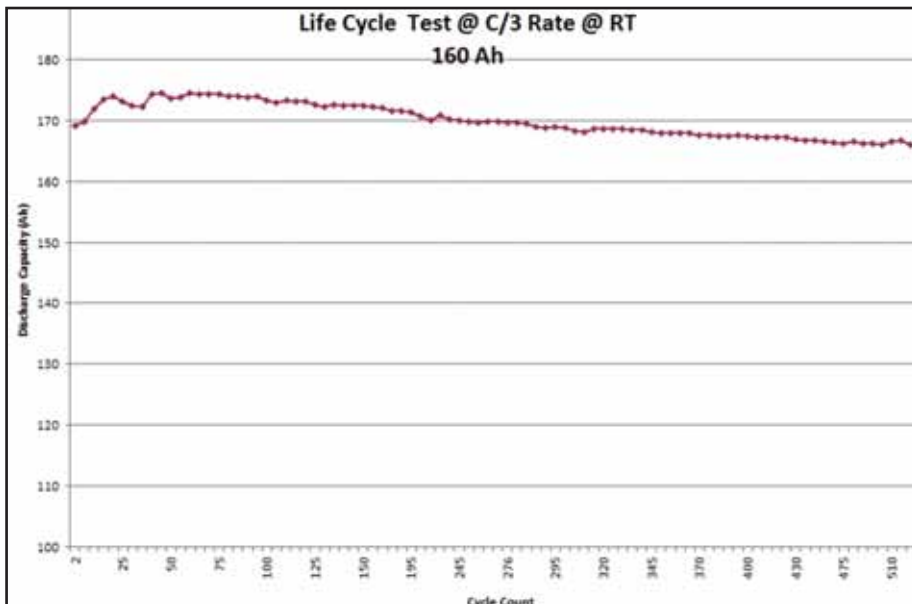


Figure 4. Cycle life room temperature at C/3 rate. Charge cut-off voltage 4.0 V and discharge cut-off voltage 2.5 V. Percent capacity fade 1.61 over last 213 cycles.

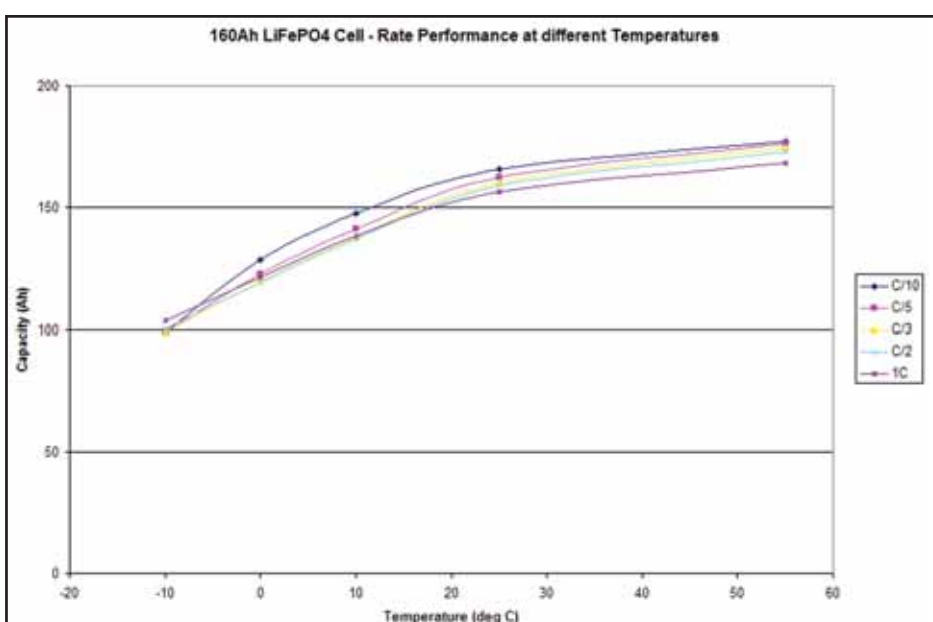
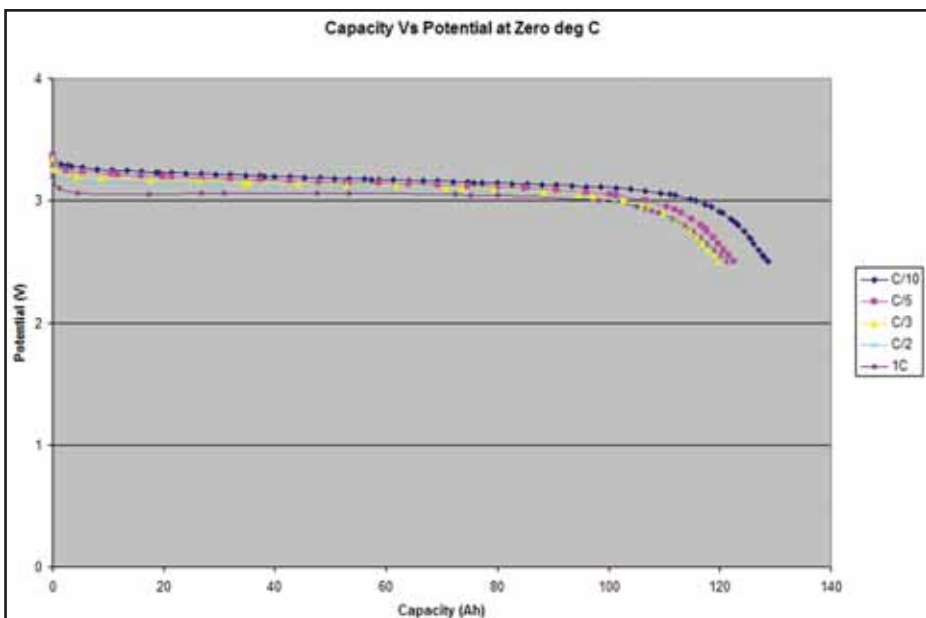


Figure 5A and 5B. Rate performance of the 160 Ah LFP cells (A) cell discharge at different rate at 0°C. and charged at C/3 (constant current and constant voltage). (B) Rate performance at different temperature and at different rates.

ing to validate the cycle life). The rate performance of the cells was tested at different temperatures and the cells show excellent capacity at low temperature and also at high temperatures (Figure 5 A and B). The test results show that the water-based Li-ion cell should perform well for long shelf life and cycle life.

Applications and Deployment

Large format Li-ion cells are now being manufactured and deployed using this well tested and proven process saving both money and the environment. Applications currently using or testing large format cells include:

- Distributed energy storage and bulk energy storage for utilities
- Heavy hybrid vehicles and large scale trucks and buses
- Military vehicles on silent watch
- Backup power for critical NASA ground operations, autonomous ground vehicles and forklifts looking to replace lead acid batteries
- Backup power for telecommunications
- Specialty medical and industrial applications

In several applications, large format cells have been deployed in the field for several years.

Conclusion

Performance results and cost analyses by International Battery indicate that water-based processing and new large format form factors are now available to help drive widespread Li-ion adoption in many key industries. Customer adoption and deployment of large format cells continues to increase and new applications are being identified to utilize the technology. In particular, as the energy content for electric vehicles and smart grid applications continues to increase, lower cost and environmentally friendly manufacturing processes will be pivotal for those industries going forward.

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Reserve Power Hybrid Systems Deliver Cost Savings for Growing Demand in Telecommunication Applications

Mike Kulesky, Marketing Director for Telecommunications
EnerSys

In remote areas across the globe such as on the continent of Africa and in the Caribbean, the demand for wireless communications is growing faster than the telecommunications companies can update their obsolete infrastructures. Unlike their counterparts in well-developed areas, the companies have poor power grids that make expanding the networks difficult.

Fortunately, recent advancements in technology have opened the door for new hybrid applications that deliver off-grid power to households and telecom base transceiver stations (BTS), or cell sites where main grid network quality is poor or non-existent. These applications often rely on diesel generators to provide either the partial or entire power supply.

"It's really a new frontier. We can connect people through reliable cell phone service in remote areas of the world; something that the rest of us take for granted," said Bob Rader, director of sales for South America and the Caribbean at EnerSys.

Today's technology has made it possible to deliver better performing batteries that support hybrid systems. In areas where the grid network is reliable, a hybrid application is characterized by a stationary battery that is working in parallel with another power source such as a diesel generator, PV panels or wind turbines. Stationary batteries by design are slightly overcharged and remain in the "float" charge mode. If an outage occurs, they can provide all of their stored energy.

In unreliable service areas, however, new stationary battery technologies that are designed to be discharged and recharged daily are a better choice for remote hybrid systems, according to John Gage, senior director of Engineering and Quality Assurance at EnerSys. For remote off-grid telecom sites, hybrid systems that use high cycle batteries in conjunction with another power source can help reduce fuel consumption and save overall operating costs.

"With rising fuel costs, telecom companies are welcoming ways to cut down the amount of time they are running generators to achieve greater cost efficiencies," said Gage.

For example, a hybrid system using a quick-charge battery would alternate a 16-hour cycle of generator power with an eight-hour cycle of battery power. In the first cycle, the generator runs to supply the power load, which simultaneously recharges the battery. In the next eight-hour cycle, the battery supplies the load while the generator is shut down. In hybrid quick-charge applications, cyclic control is necessary to allow the battery to achieve its eight-hour discharge and fully recharge from the generator in 16 hours, so it is ready for the next discharge.

New Technology Permits Greater Control

Depending on the application, battery requirements can vary drastically. For instance, powering a stand-alone hybrid application system is a much different animal than supplying backup power with the traditional valve-regulated lead acid (VRLA) standby battery. For efficient systems, it's important to select the battery and design the system carefully while considering the characteristics of each unique operating environment.

Through the latest technologies in manufacturing capabilities and process control, manufacturers can produce more cycles from every battery. Network engineers benefit from newer, more intelligent power equipment that gives them more accurate measurements and control of charging and discharging batteries through proprietary algorithms.

"Hybrid systems that offer quick-charge methods combined with our SBS EON technology for off-grid power are the best choice for supplying power to remote areas, which is typically not how traditional VRLA batteries have been used," said Gage. "When the batteries are built with enhancements like SBS EON technology, they can support quick-charging methods that are commonly used in motive power applications. It's a new frontier in hybrid systems."

Meeting Demand for Remote Applications

In the case of remote applications using a hybrid system, VRLA stationary standby batteries are actually used as one of the main sources of power. In stand-alone hybrid applications, the batteries work more like those in motive power lift trucks or handling trucks because the standby batteries are discharged daily. The charging method is the key to achieving the full life expectancy of the battery.

To meet the output demands and be available for any potential power failures, analyzing the unique requirements of the network is critical when choosing the battery. In many cases, remote off-grid telecom applications use two diesel generators to give constant power to the systems. Some applications have a battery for backup power when generators break down or run out of fuel, leaving the operator minimal time to react.

Hybrid Systems Generate Cost Savings

Site operators have found tremendous cost savings when the battery has a major role as an energy source. Rader noted that the major benefits cited by telecom operators are reduced generator run-time, lower fuel costs and less frequent maintenance for generators, especially since many sites only need one generator rather than two.

Site operators ideally would run exclusively on grid power with a back up solution of batteries and eliminate the costs of fuel and equipment. However, in many parts of the world, quality electric grid service is a luxury. Within these areas, there are several aspects to consider in order to achieve the battery's expected lifetime and to meet the needs of the network. Here are the four major points to determine if the standby application will provide ample power.

1. Cycle Life, Effect of Deep Discharge

This is a key parameter to correctly size a system. VRLA battery cycle life depends on the amount of energy discharged at each cycle. While every battery design varies, as a general rule, a battery is capable of providing a finite amount of amp hours in its whole life. If a certain amount is discharged at every cycle, the battery can provide many cycles, whereas depleting the whole capacity at each cycle results in a shorter cycle life.

2. Time to Recharge, End of Charge Detection

The systems often use many battery elements or blocs in series. To achieve the expected cycle life, they have to be fully recharged and homogenous at each cycle. So using float charging voltages that are commonly used in stationary applications is not suitable. If a typical stationary battery that is on float charge has been discharged to 80 percent of its rated capacity, it needs 24 hours to fully recharge. Recharge time can be reduced even lower (two to three times) with alternative batteries using thin plate pure lead technology, if the available current is sufficient.

3. Available Charge Current

There is a minimum current to properly charge a battery at each cycle. To optimize the hybrid system, it's ideal to use the generator for the minimum time to recharge the battery. The generator size is important yet in many cases, an oversized generator already exists at many sites and is being underutilized. When the generator is operating, it normally has excess power that ideally could be used for proper or quick-charge methods.

4. End of Discharge Detection

Overcharging affects the cycle life, so it's important to detect the end of discharge by measuring the amount of amp hours the system used. This isn't an option in older power generation systems, so the battery manufacturers often estimate the cut-off voltage to a given depth of discharge. The estimation method is not recommended for quick-charging since there is a risk of over- or under-charging the batteries.

The New Hybrid is a Success

Using hybrid systems in remote areas of the world is gaining traction. They provide a cost-effective and environmentally-conscious means for creating a renewable independent power source in areas that would otherwise have unreliable service or no power at all.

In one application in North Africa, the hybrid powered a wireless cell tower. By day, it ran on battery power for four to eight hours. At night, the generator ran to keep the cell tower in operation.

"The cost savings in fuel alone justified the site's investment in the hybrid," said Gage. Another company reported an approximate 20 percent savings due to better fuel efficiencies. "The new hybrids are becoming popular tools to manage power loads, give extended runtime solutions and make positive green-minded decisions."

A telecom business veteran of more than 10 years, Mike Kulesky is director of Marketing for Telecommunications at EnerSys. Previously, he worked at Lucent Technologies, supporting a wide range of power projects and products.

Contact EnerSys at www.enersys.com.

Battery Welding Solutions Using Laser and Resistance Technologies

Geoff Shannon
Miyachi Unitek Corp.

The ever-increasing demand for portable electronic devices, cordless power tools, energy storage and hybrid and EV cars has become an integral part of everyday life, driving the need to produce batteries and battery packs to meet these needs. That, in turn, drives the call to manufacture batteries that meet or exceed the quality and production requirements of the same.

In battery manufacturing, there are a number of materials joining requirements. Depending on the specific type, size and capacity of the battery these may include internal terminal connections, can and fill plug sealing, tab to terminal connections and external electrical connections. There are a number of joining options that can be considered for each of the requirements including resistance, ultrasonic and laser welding. Ultrasonic welding is commonly used for the joining of the internal electrode battery materials that are usually constructed of thin foils of aluminum and copper. The remaining joining requirements, including the connections inside the can and external terminal tab connections, are well suited to both resistance and laser welding; the decision to use one or the other is generally dictated by the specific type of weld required and production requirements. For can and plug applications (seam sealing) laser welding is the joining technology of choice.

Introduction

Resistance welding has been an established joining technology for more than 40 years and has been used in the battery industry for almost as long. Since then, a steady stream of advances in resistance welding systems has given users significantly improved capabilities to control various aspects of the process. For example, the introduction of DC inverter power supplies with basic closed-loop electrical modes provided the ability to accommodate changes in the secondary to specifically address part resistance. Also, polarity switching for capacitance discharge supplies to enable balancing of the weld nuggets, and more recently, the addition of displacement and electrode force measurement, provide manufacturers with more tools to ensure weld quality.

Laser welding is a newer technology, introduced in the manufacturing marketplace in the mid-1980s. As laser technology has matured, and the awareness thereof spread, it has become an established process so that today, it is simply another tool in the manufacturing engineer's toolbox to be used and implemented as needed. The laser provides a high intensity light source that can be focused down to very small diameters (0.01 inch). The concentration of light energy is sufficient to melt metals rapidly, forming an instantaneous weld nugget. The process is non contact, has no consumables, offers instantaneous welding once positioned at the weld point location, provides sufficient control over the process to size the weld nugget according to requirements, and provides a number of implementation methods that can be geared toward individual manufacturing requirements. Laser welding enables joining of many materials and material combinations, can weld thick parts, and has no limitation on proximity of weld spots. There are two types of laser that provide solutions for battery applications: pulsed Nd:YAG and fiber. Both of these lasers offer different joining characteristics that can be selected as appropriate.

Lead Acid Batteries

The manufacture of reliable, high-performance lead-acid batteries for use in demanding automotive, marine and storage applications poses significant challenges. The welding application requires that a series of lead castings (tombstones), which constitute the cores of the individual battery cells, be joined. These lead tombstones must be linked together using consistent and precisely controlled weld nuggets in order to assure the proper operation and long-life of the final battery assembly.

The welding challenge arises due to the high level of resistance variability that occurs based on the age of the lead, and these variations happen over a period of less than 72 hours. Controlling batch parts according to age, therefore, is not viable in production. The resistance variation makes it very difficult to achieve consistent results with traditional AC resistance welding, which is susceptible to current spikes and inherent variability in the welding process. Even the use of advanced AC weld controls, which have a more consistent secondary current output, is not sufficient; operators must continually adjust weld parameters to maintain acceptable welds.

The most effective approach to the unique challenges of lead-acid battery welding is to use advanced inverter (DC) solutions that combine precision controlled secondary power (V x I) with comprehensive monitoring and real time feedback mechanisms. By sensing and adapting for differences in resistance in the lead castings, as well as

other variations in the weld process (e.g. electrode wear, cabling, etc.), these systems can automatically maintain constant power and consistent heating profiles at the weld nugget. As a result, inverter controls using constant power feedback are able to deliver dramatically increased yields while simultaneously eliminating the inefficiencies and inconsistencies of operator-dependent process tweaking. Among the most significant benefits is the expansion of the effective process window from only 15 minutes between schedule updates for AC controls, to as long as 72 hours without any necessary operator adjustments for the inverter.

High Speed Seam and Plug Sealing of Battery Cans

Laser welding is an excellent method for seam sealing, resulting in a high speed, high quality hermetic seams in both steel and aluminum. Laser welding offers significant advantages over mechanical clinching and adhesive methods based on joint reliability, joining speed and ease of manufacturing. As laser welding is an extremely efficient joining process, the heat input into the battery is minimized.

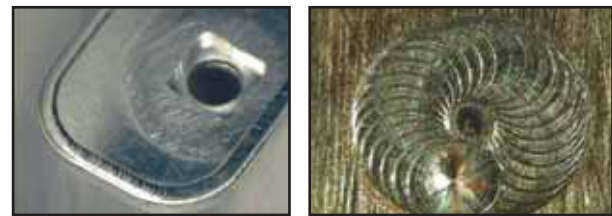


Figure 1. Seam welding of aluminum cans for various battery sizes with weld cross section, and ball and plug sealing application example.

Welding Tabs to Terminals

From a welding perspective, the important aspects of tab welding are the thickness and material of both the tab and the terminal. Resistance welding is extremely well suited to welding nickel tab material up to 0.015 inch thickness, and nickel or steel clad copper tab material to around 0.012 inch thickness to a wide variety of terminal materials. Due to a different welding mechanism, laser welding is able to weld both thin and thick tab materials, with a capability of welding copper based or bi-metal tab material above and beyond 0.04 inch thickness.

Miyachi Unitek Continued on Page 16



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Figure 2. A few examples from the wide range of resistance tab welding applications.

Resistance Welding

Resistance welding is the most cost-effective method for joining tabs on a wide range of battery types and sizes, using both DC inverter closed loop and capacitor discharge power supplies. With fast rise times, closed loop feedback control, polarity switching, and options for displacement and force sensing, the process can be finely tuned and monitored to ensure both high quality and yield. For nickel tab thicknesses up to 0.007 inch the tab can be welded without modification. Beyond this thickness, and to prevent electrical shunting and excessive electrode wear, a slot and projections are placed in the tab as part of the stamping process. The projections act not only as energy concentrators for the weld, but also greatly increase electrode lifetimes.

Laser Welding

Although able to weld both thin and thick tab materials, laser welding is particularly well suited to addressing the needs of high power battery welding. The tab material used in the development of high power cells must be able to accommodate the associated higher capacities and power levels. In order to provide efficient energy transfer, a tab thickness of 0.015 inch or greater is required, as is the use of more conductive materials. For high power lithium ion cells, the terminal material for certain battery manufacturers is different. Therefore the need for bi-metal and smart terminal design solutions is required. Defining the optimal tab material may require some development work both on the welding and material costing. In these cases, the laser is an invaluable tool that offers outstanding welding performance and flexibility.

Laser Welding - Flexible Weld Pattern

As laser welding has no limitation on the proximity of the welds, the laser can place any pattern of weld spots on the tab according to strength requirements. It is worth

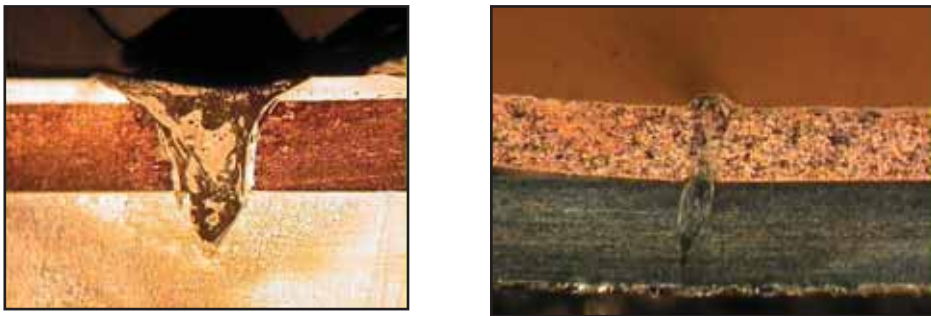


Figure 3. Laser welding examples of thick conductive tab welding. (a) Nd:YAG laser 0.02 inch thick steel clad copper tab to steel (b) fiber laser weld 0.012 inch thick copper to thin stainless steel.

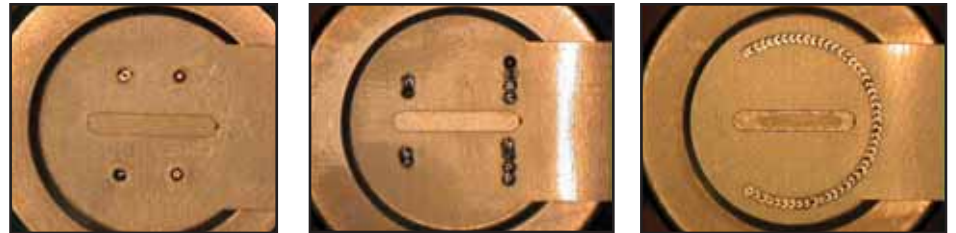


Figure 4. Examples of flexible weld placement for tailoring weld strength and weld strength and direction of weld strength can be tailored to pack requirements. The peel strength of (a) and (b) is 15 lb and 60 lbs respectively.

noting that in nearly all cases if the weld strength of the joint is achieved, conductivity follows. For more conductive materials, the weld area required for strength can be as much as 10 times that required for conduction.

As shown in Figure 4 the placement of the weld spots on the tab is completely flexible, and can be tuned to the strength requirements of the pack or tab. For example, peel strength is often used as a metric for weld quality therefore the welds can be positioned to accordingly. The time needed to add additional weld spots is very short; sufficient tab strength can be achieved with very little impact on cycle time.

Although peel strength remains an important weld test, vibration is also important. As vibration strength places an emphasis on having good weld strength in any direction, the circle of weld spots shown in Figure 4 provides the solution.

Laser Welding - High Speed Solutions

As the process is non contact and the beam is steered by motion the welding speed is determined by the tab materials and thickness and the terminal material along with the selection of laser power. As an example shown in Figure 5 a 0.012 inch thick nickel plated copper tab is welded to an aluminum terminal at 4"/s.



Figure 5. Lithium ion battery with 0.012 inch thick nickel plated copper tab welded to aluminum terminal at 4"/s.



Figure 6. XY gantry laser based solution for battery pack welding, where the pack remains stationary and the focus head is moved.

Pack Manufacturing Solutions

When planning an automated or semi automated solution, the primary factors to consider are loading/unloading, motion and tooling that fit the planned production flow and production rate. Loading and unloading can range from manual to conveyer or pick-and-place, motion options center around whether the resistance/laser head or the part will be moved, with options including XYZ tables and gantry's or robotic manipulators. For tooling, resistance welding occurs by the actuation of an electrode onto the tab, and is therefore self tooling. The laser is non contact, so tooling of the parts can be achieved either by using a fixture that the batteries and tabs are loaded into, or using actuated tooling that is deployed prior to the welding process.

The most suitable technology and process for battery pack manufacture relates to a number of factors including the pack size, thickness and material of the tab itself, and the necessary production rate. Both laser and resistance welding processes enable high quality volume production, and, as there is welding overlap of the two joining technologies, the selection is usually made based on the specific requirements in each situation.

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New Safety Requirements for Large Battery Cells and Packs to Help Address Industry's Concerns Regarding Public Safety

Underwriters Laboratories (UL), has announced its intent to release a new set of requirements for large batteries in electric vehicles, UL Subject 2580. With interest in electric vehicles on the rise, these new requirements will help mitigate the potential risk of fire and electrical hazards and enhance the overall safety of batteries for electric vehicles. Before becoming a standard, these requirements will undergo a comprehensive review process by a global Standard Technical Panel (STP). An STP is a consensus body of individuals representing consumers, government agencies, regulatory authorities, manufacturers and other knowledgeable interested parties that develop and maintain effective product safety standards.

The use of electric vehicles is expected to increase significantly in coming years, mainly due to the cost of traditional fuels and rising environmental concerns. Billions of dollars are being invested globally to develop and promote this technology, including almost three billion dollars from the 2009 American Reinvestment and Recovery Act. According to the international consulting firm Oliver Wyman, the estimated number of plug-in hybrid electric vehicles (PHEV) and battery-electric vehicles (BEV) that will be on the road globally over the next decade range from 1 to 5 million new vehicles per year. Along with this rapid growth comes the potential for fire, electric shock and other safety hazards.

"There are a number of factors in the industry that will dictate the rate of proliferation of electric vehicles on the market, which include cost, performance, durability and safety requirements for large batteries," said Jeff Smidt, global manager of Underwriters Laboratories Global Energy Business. "At UL, safety remains our number one concern. With the help of our new and existing safety requirements, we are helping manufacturers get safer vehicles to the market."

While UL Subject 2580 will not be mandated, manufacturers will have the option of certifying to its requirements to help reduce risks. Currently, there is no UL standard for the testing of large batteries like these in electric vehicles.

In addition to developing new standards for large batteries, UL has been conducting tests and certifying to existing standards for numerous hybrid and battery-electric vehicle components. Some of these components include motors, connectors and battery chargers. UL tests these components for overload protection, shock and flammability among other hazards. Ultimately, UL's requirements for electric vehicle safety help move the industry toward performance and safety standardization.

Springs Built from Nanotubes Could Provide Big Power Storage Potential

New research by MIT scientists, led by associate professor of mechanical engineering Carol Livermore, suggests that carbon nanotubes, tube-shaped molecules of pure carbon, could be formed into tiny springs capable of storing as much energy, pound for pound, as state-of-the-art lithium-ion batteries, and more than 1,000 times as much as steel springs, and potentially do so more durably and reliably.

Ultimately, such springs might be used for such applications as an emergency backup power supply or alarm system that can be left in place for many years without losing its "charge," portable mechanical tools like leaf blowers that work without the noise and fumes of small gasoline engines, or devices to be sent down oil wells or into other harsh environments where the performance of ordinary batteries would be degraded by the extremes of temperature.

Livermore and her team did a combination of mathematical analysis and small-scale laboratory testing to determine the potential of carbon nanotubes to be used as springs for energy storage.

Livermore says that to create devices that come close to achieving the theoretically possible high energy density of the material will require plenty of additional basic research, followed by engineering work. Specifically, the initial lab tests used long fibers of individual carbon nanotubes joined end-to-end, but creating a practical energy storage device will require assembling nanotubes into longer, thicker fibers without losing their key advantages.

Proposed Ban on Air Transport of Lithium Batteries Threatens Shipments to Hospitals and Soldiers

The Rechargeable Battery Association strongly opposes a recent request by the Air Line Pilots Association asking the US Department of Transportation to ban the air transport of lithium batteries.

The ALPA filing threatens both emergency shipments of batteries needed to power life-saving medical equipment such as portable oxygen concentrators and restricts mission-critical battery deliveries to US military installations, significantly compromising our soldiers' ability to carry out their mission, PRBA stated in a September 4 letter to the DOT's Pipeline and Hazardous Materials Safety Administration.

ALPA's request also "ignores the vital role that these batteries play in powering just about every common portable electronic device," including cell phones, notebook computers, digital cameras, portable DVD players and just about every other ubiquitous consumer electronic product that has revolutionized the mobility of Americans, the PRBA letter stated. "A ban on such shipments would also disrupt distribution of many other products on which US consumers, government agencies and businesses have come to rely."

In its letter, PRBA urged PHMSA to strengthen its safety regulations by moving

quickly to harmonize US battery rules with the far more stringent shipping and packaging provisions applicable in the rest of the world. PHMSA and the Federal Aviation Administration should also expand enforcement of existing US regulations.

"We would like to see FAA take a more pro-active approach on enforcing the existing regulations because they are the lead agency on air safety," said PRBA executive director George Kerchner.

For example, ALPA has cited three incidents to justify its call for a ban on air shipment of lithium batteries, but in each case the shipments failed to comply with even existing US hazardous materials regulations, including labeling and packaging requirements, the letter noted. "Similar flaunting of the regulations has been involved in virtually all the lithium ion battery shipping incidents over the last few years," the letter stated.

PRBA also takes exception to ALPA's assertion that there are similarities between these three incidents and the 2006 UPS plane event at the Philadelphia airport. The National Safety Transportation Board stated that the cargo fire was initiated by an unknown source, PRBA's letter said.

"The ban ALPA advocates would penalize the patients, soldiers, businesses and consumers who rely on lithium batteries and the responsible shippers who comply with existing requirements, without addressing the real problem that is present. ALPA's proposal should be rejected," the letter concluded.

NextGen Research Predicts a "Power Shortage" in Batteries And Fuel Cells

As portable devices have become smaller in size and richer in features, their power needs have grown, but battery designers and manufacturers have not been able to keep pace by squeezing more energy into less space. Existing battery chemistries are approaching the limits of their energy densities, creating the potential for a "power shortage" as increasingly smaller gadgets make growing demands on batteries that cannot provide sufficient sustained power to take advantage of the latest power-hungry features.

A new study by NextGen Research, "Batteries and Fuel Cells: Portable Power for Portable Devices," forecasts that the market for such portable power products will mirror the global economy: contracting in 2009 and seeing negligible growth in 2010, with more robust growth beginning in 2012. Overall, NextGen Research projects the global market for batteries and fuel cells for portable products will grow from \$46 billion in 2009 to almost \$64 billion in 2013.

"This is a staid, conservative market, where developments are evolutionary, not revolutionary," said Larry Fisher, research director of NextGen Research. "This does not bode well, because portable devices increasingly require more power, and battery designers and manufacturers do not have a near-term solution to ameliorate the problem. The latest generation of smartphones serves as a perfect illustration, with consumers complaining loudly about the shrinking battery life of these devices."

The NextGen Research market study foresees incremental improvements in both the primary (disposable) and secondary (rechargeable) segments of the market, such as faster recharge times for lithium-ion batteries, and tweaks in chemistries that provide performance enhancements in both primary and secondary batteries. However, NextGen Research does not anticipate any major technological developments in the near term; lithium-ion will continue to be the principal chemistry in secondary bat-

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teries, while alkaline and carbon zinc will continue to dominate the primary battery market. Much-heralded micro-fuel cells will not gain traction in the market until late in the forecast period.

Fisher noted batteries also will be growing more eco-friendly in the coming years. "Environmental concerns are driving manufacturers to reduce or eliminate the use of cadmium, mercury and other dangerous substances in their batteries. At the same time, the drive to recycle spent batteries is just beginning to take hold."

Development of New Lightweight Battery for Electric Cars

Ricardo, Inc., the US subsidiary of Ricardo plc, has announced that \$2.1 million of funding has been made by the UK Technology Strategy Board to a consortium led by advanced battery manufacturer Axion and including Ricardo, which will develop a new lightweight battery for use in electric small city cars, improving their performance, functionality and range. The aim of the project is to develop an innovative high energy density battery system for an emission-free electric small city car. The battery, which will use new cell chemistry that offers higher energy density, will be lighter, smaller and therefore more efficient than those currently available, and will offer faster charging and a higher range.

The benefits of the newer technology from improved performance, functionality and range will be significant. These factors in turn will enhance the appeal of low carbon electric vehicles (EVs), and if take-up is as predicted (250,000 new EVs by 2015 in Europe alone) it would contribute to a significant reduction in the UK's CO₂ emissions. In addition to Axion and Ricardo the consortium will also include as a member Allied Vehicles, a niche vehicle manufacturer.

Over the next 22 months, Ricardo will develop the battery management system architecture and application software; Axion will engineer and construct the battery system, perform cell testing for calibration and electronic system integration; and Allied Vehicles will design, build and test the vehicle platform.

Electric Transmission Texas Signs Contract for Largest Utility-Scale Battery in the US

Electric Transmission Texas LLC (ETT) has completed a contract with NGK-Locke, Inc. for a state-of-the-art, sodium-sulfur 4-megawatt NAS battery system, which will be installed in Presidio, Texas. ETT is a joint venture between American Electric Power and Mid-American Energy Holdings Company.

The NAS battery will be the first in Texas and the largest in the US and represents part of a \$67 million overall commitment by ETT to improve transmission reliability in Presidio and surrounding areas.

The battery, along with construction of the Gonzales substation, is currently scheduled to be completed by first quarter 2010 in time for summer peak usage. Cost of the battery and substation is estimated at approximately \$23 million. A 60-mile, 69-kilovolt transmission line from Marfa to Presidio is targeted for completion by 2012 with an estimated cost of approximately \$44 million.

"Very soon, one of the oldest cities in the United States will be benefiting from one of the world's newest technology developments," said Calvin Crowder, ETT president. "This battery installation will enhance electrical service for our customers in this region, and completion of this contract will allow the Presidio area to realize its benefits by next summer."

AEP pioneered the use of the NAS battery in the US. Following testing at its Dolan Technology Center near Columbus, Ohio, AEP became the first US company to deploy NAS batteries in 2002 when it installed and operated a demonstration unit in Gahanna, Ohio. In 2006, AEP installed a 1.2-megawatt stationary NAS battery near Charleston, W.Va. In 2008, AEP installed three, 2-megawatt NAS batteries: one in Churubusco, Ind.; one in Balls Gap, W.Va.; and one in Bluffton, Ohio.

ETT acquires, constructs, owns and operates transmission facilities within the Electric Reliability Council of Texas (ERCOT), primarily in and around the AEP Texas Central Company (TCC) and AEP Texas North Company (TNC) service territories.

International Battery Awarded \$2.1 Million in Federal Funding To Develop Advanced Batteries for US Army

International Battery, a US manufacturer, designer and developer of large-format Lithium-Ion rechargeable cells, has been awarded \$2.1 million in federal appropriations funding. This award will fund work aimed at the development for a new Silent Watch system with high energy storage capabilities for use in US combat tactical vehicles.

The Non Primary Power System (NPS 1160) is modeled on International Battery's large format Iron Phosphate cells and Battery Management System (BMS) technology manufactured in the US. The goal of this program is to test and deliver prototypes aimed at creating increased power in military combat and silent watch vehicles. The potential for this technology is very significant in both size and growth in these modular systems. With the added rolling Silent Watch requirements and tight space claims within the military, these systems offer the scalability and modularity to fit multiple platforms.

International Battery's US based manufacturing facility will offer several advantages in the rapid development of Iron Phosphate batteries including: clean and environmentally safe setting through the use of its water based manufacturing process; higher energy density and longer life cycle than those achieved from current conventional lead-acid batteries.

International Battery's award is among an initial base contract with several options to follow that will allow a path for International Battery's strength of engineering and manufacturing to lead Silent Watch technologies into the future. The total funding package will help to create International Battery's future capability of adding more high-paying jobs in Allentown, Penn. This technology footprint represents additional market growth capability for the commercial markets, such as trucks, buses and future stationary power applications.

Blue Spark and Novalia Partner to Design and Develop Creative, High Value, Interactive Printed Electronics Products

Blue Spark Technologies, a supplier of thin, flexible printed battery solutions, and Novalia, a designer of printed electronics products, recently signed a joint marketing agreement to drive the creation and launch of innovative "Interactive Printed Media" products for the publishing, consumer, packaging, retail and other markets.

Novalia's Interactive Printed Media (IPM) vision is based on existing printed electronics technologies. Technologies include programmable chips (ICs) and conductive inks, used along with traditional graphic inks, and thin, flexible "green" batteries as a primary power source. Printed electronics, by design, can easily and

affordably be integrated into standard manufacturing processes and printed using traditional print processes, such as screen, offset, gravure and flexography.

Peter Kuzma, vice president of Business Development for Blue Spark Technologies, commenting on the new partnership, said, "Novalia has emerged as a leader and pioneer in interactive printed electronics technology. We at Blue Spark look forward to an exciting and productive marketing partnership that effectively leverages Novalia's design creativity and printed media expertise with Blue Spark's extensive experience in engineering, battery-powered electronic design, prototyping and product testing."

Dr. Kate Stone, CEO of Novalia said, "In our world, virtually any printed item can be made interactive, which is why we believe the market potential for Interactive Printed Media is enormous. Novalia strives to provide customers with creative designs and compelling applications to help them launch high value interactive products that are inviting and engaging for end users. Blue Spark's disposable printed batteries provide the ideal power source to activate many of these products."

Novalia has developed a compact, self-contained printed electronics control module consisting of a power source, integrated circuit for I/O control and interaction flow, and a sound

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transducer. The integration of the module and conductive inks enables the printed item to communicate and interact with the end user (consumer) through the senses of touch, sight and sound. The specific nature of that interaction will depend on the programming of the chip.

As part of their agreement, Blue Spark and Novalia are performing customer specific seminars on the role interactive printed media can have in increasing sales and driving brand awareness across a number of consumer and industrial related industries. IDTechEx predicts the electronic packaging segment of this market alone, to reach \$7.7 billion by 2010.

Mizzou Scientist Develops a Nuclear Battery that Uses a Liquid Semiconductor

Batteries can power anything from small sensors to large systems. While scientists are finding ways to make them smaller but even more powerful, problems can arise when these batteries are much larger and heavier than the devices themselves. University of Missouri researchers are developing a nuclear energy source that is smaller, lighter and more efficient.

“To provide enough power, we need certain methods with high energy density,” said Jae Kwon, assistant professor of electrical and computer engineering at MU. “The radioisotope battery can provide power density that is six orders of magnitude higher than chemical batteries.”

Kwon and his research team have been working on building a small nuclear battery, currently the size and thickness of a penny, intended to power various micro/nanoelectromechanical systems (M/NEMS). Although nuclear batteries can pose concerns, Kwon said they are safe.

“People hear the word ‘nuclear’ and think of something very dangerous,” Kwon said. “However, nuclear power sources have already been safely powering a variety of devices, such as pace-makers, space satellites and underwater systems.”

Kwon's innovation is not only in the battery's size, but also in its semiconductor. The battery uses a liquid semiconductor rather than a solid semiconductor.

“The critical part of using a radioactive battery is that when you harvest the energy, part of the radiation energy can damage the lattice structure of the solid semiconductor,” Kwon said. “By using a liquid semiconductor, we believe we can minimize that problem.”

Kwon has been collaborating with J. David Robertson, chemistry professor and associate director of the MU Research Reactor, and is working to build and test the battery at the facility. In the future, they hope to increase the battery's power, shrink its size and try with various other materials. Kwon said that the battery could be thinner than the thickness of human hair. They've also applied for a provisional patent.

Illinois' First Hybrid School Bus

The largest family-owned and operated school bus contractor in the US has purchased the first hybrid school bus in Illinois. The new vehicle drives like a standard school bus but comes equipped with both hybrid and diesel systems that work in tandem to drastically cut emissions and more than double fuel efficiency. Kickert, a Cook-Illinois Corp. subsidiary, will transport kids to and from Huth Junior High School in Matteson, Ill.

“School buses obviously start and stop constantly, and this is exactly what a hybrid system needs to stay efficient. We also think it is something that will save fuel and provide a better environment for the children we transport now and the children of the next generation,” explains Cook-Illinois COO John Benish, Jr.

On average, a diesel-powered school bus gets six miles to the gallon. The hybrid gets up to 13 miles per gallon, making it twice as efficient and cost-effective as a diesel-powered bus. The hybrid bus is manufactured by IC Bus Corp., headquartered in Warrenville, Ill., an affiliate of Navistar, Inc.

The Cook-Illinois hybrid bus is a charge-depleting system, meaning it uses battery energy stored during overnight charging or between routes to offset fuel costs. The hybrid bus comes with a diesel engine and a hybrid system which work together by gathering energy when the brakes are used, charging the battery as the bus decelerates. This gathered energy provides additional power when the bus accelerates, allowing the diesel engine to mostly idle while the bus increases speed. The lithium-ion battery used in the charge-depleting hybrid lasts five to seven years. The lifespan of a hybrid bus is about 12 years, mirroring that of a diesel-powered bus.

New Duracell Smart Power Initiative Takes the Brand Beyond The Battery

Duracell has launched its new Duracell Smart Power initiative, which expands the brand's product portfolio beyond the traditional battery to address the ever-growing and ever-changing power needs of the modern consumer. The company's latest offerings, such as the new drop-and-go myGrid charging pad, fall under an emerging category of personal power solutions and signify Duracell's commitment to keeping today's consumers connected to the devices they need the most at all times.

Duracell Smart Power and its range of personal power solutions continue the company's focus on reliability, performance and technological innovation but now deliver added power efficiency allowing consumers the freedom to live beyond the grid. More than 10 new products mark the start of Duracell Smart Power ranging from myGrid to on-the-go compact power chargers, new rechargeable battery chargers and LED technology for flashlights.

According to Rick June, Duracell vice president and general manager, North America, “Our new personal power solutions allow consumers the freedom to live their lives without the limits of staying tethered to today's power grid. It is charging made simple.”

Better Place Targets Tokyo Taxis for Battery Switch Application

Better Place has received an award from the Japanese government to conduct a pilot project in Tokyo for the world's first electric taxis with switchable batteries. Better Place will partner with Tokyo's largest taxi operator, Nihon Kotsu, in the project commissioned by the Ministry of Economy, Trade, and Industry's Natural Resources and Energy Agency. The project, which

comes on the heels of the company's successful battery switch demonstration earlier this year in Yokohama, is slated to begin in January 2010.

“Japan continues to be a leader in automotive engineering and innovation, and the government's funding of Better Place for the world's first battery switchable electric taxis is a testament to the country's commitment to sustainable transportation,” said Kiyotaka Fujii, president of Better Place Japan and Head of Business Development for Asia Pacific. “This puts the Better Place battery switch system to use in a real-world application involving heavy-use vehicles that drive much more than the average passenger car. It also enables us to begin to convert taxis to clean, zero emission transportation.”

Japanese taxis represent two percent of all passenger vehicles on the road in Japan, yet they emit approximately 20 percent of all carbon dioxide (CO₂) from vehicles due to their average distance traveled in a given day. In Tokyo alone, there are approximately 60,000 taxis, a far greater number than in New York, Paris or Hong Kong. The outcome of the Tokyo pilot program for electric taxis could point to opportunities in other urban centers. Additionally, success within the heavy use taxi industry will help to ensure efficient technology transfer to the mass market, where daily mileage is far less on average.

The electric taxi pilot will showcase the everyday use applications of the Better Place model, and will involve the construction of a Better Place battery switch site at a location in the Roppongi Hills area in Central Tokyo. Up to four newly modified and fully operational electric taxis will be operated from an existing taxi lane for environmentally-friendly vehicles at the Roppongi Hills complex.

Tokyo R&D Co., a specialist in automotive engineering and production, will supply the EVs based on commercially available vehicles with the necessary battery latch mechanisms and switchable batteries. Tokyo R&D also will be involved with building the battery switch site and provide diagnostic software for the pilot.

The vehicles will be put into standard taxi service by the Nihon Kotsu taxi company. Battery switching duration, vehicle range and battery resistance to degradation will be tested under actual operating conditions.

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DPMC Awarded Patent for an Improved System and Method For Monitoring State of Health of Battery

Data Power Monitoring Corp. (DPMC), a provider has been awarded a US patent for key technologies and methods for its "System and Method for Remote Monitoring of Battery Condition." This patent has already been commercialized by DPMC and is in force today supporting thousands of critical backup battery systems via DPMC's battery automated reporting system or "BAR" managed services offering.

"Today's society is increasingly dependent on IT systems that rely on continuous backup power or stored energy to deliver financial transactions, reliable cell phone service, email systems, security systems and more," said Steve Cotton, president of DPMC. "The BAR system serves as a foundation of DPMC's scalable monitoring programs and is unmatched in the way it integrates software as a service and methodologies with our skilled battery experts."

The BAR interface works with all leading industry battery monitor offerings and incorporates key battery related IEEE standards into DPMC's technology and methodologies. The BAR system is the result of over six years of development, and is built on a UNIX platform for maximum reliability and scalability. The patent covers technologies and methodologies related to the ability to remotely communicate with any type of battery monitor device, and to standardize and graphically display data collected for a common user friendly web-based interface with continual embedded and contextually sensitive human analysis of data and recommendations by battery experts. This combination of standardized reporting and human analysis provides both high uptime of backup power systems as well as life extension of perishable battery assets, which save millions of dollars for each of DPMC's customers.

"Periodic manual monitoring, as is the status quo in traditional systems, can provide only a temporary indication of the battery condition and achieving certain reliability requires a combination of automated data collection, storage and trending combined with analysis by experts who knows how to interpret the data and act," added Cotton.

The BAR also offers cost-effective daily battery monitoring using data trending to reduce reliance on traditional and expensive manual maintenance methods which only provide periodic spot checks. Key performance trends are accelerated by the BAR which stores archived data to determine various characteristics of the batteries

monitored. Trends of several data points may be monitored to indicate each individual battery's state of health including Ohmic (resistance or impedance) value, temperatures, voltage, or time periods for batteries used to power customers' systems.

Standardization Key for Wireless Charging in Handsets

The Wireless Power Consortium's announcement of a draft standard marks a key milestone for wireless charging technology. With a standard in place, wireless charging offers a unique product differentiator not only for mobile handsets, but for an entire ecosystem of portable electronic devices.

Although wireless charging technology has been common in products like electronic toothbrushes and shavers for years, the technology gained significant media attention from those covering the mobile handset market with the release of the Palm Pre earlier this year. Now that a draft standard for the technology is in place, a key hurdle for increased penetration in the mobile handset market has been cleared.

"The real value of the technology lies in the ability to charge a range of devices with the same charger," said IMS Research analyst, Chris Schreck. "While proprietary wireless charging implementations offer some novelty for tech enthusiasts, a wireless charger capable of recharging a consumer's laptop, camera, personal media player, and mobile handset offers a much better value proposition to the user."

A standard is also critical for developing an ecosystem of chargers in more places than just the home or office.

"The nice thing about standardization is that now, for example, a coffee shop can consider integrating the technology into a table, which would charge your laptop and handset when you sit down," Schreck continued. "And one can think of any number of places, from a conference table to an airplane tray table, where wireless power for a portable device would be convenient. A standard makes these scenarios more economically feasible, even if still far off in the future."

As mobile handsets continue to evolve, and power becomes an increasingly precious commodity in handsets, wireless charging shows the potential to carve out a niche in the handset market. IMS Research predicts over 11 percent of mobile handsets shipped in 2014 will feature wireless charging capabilities. Key to that market penetration is the continued development of an acceptable standard that supports penetration in a range of portable electronic devices.

H&T Waterbury, Inc. Awarded US Department of Energy Stimulus Grant

H&T Waterbury, Inc. has released that the National Energy Technology Laboratory has confirmed an award of \$5 million in federal stimulus grant money under the US Department of Energy Recovery Act – Electric Drive Vehicle Battery and Component Manufacturing Initiative.

H&T Waterbury was one of 30 successful applicants in the category of US based manufacturers to produce batteries and their components. H&T Waterbury, located in Waterbury, Conn., is the headquarters of H&T Battery Components, a division of the Heitkamp & Thumann Group, a privately held company headquartered in Dusseldorf, Germany. The Group employs approximately 2,000 people worldwide and has global sales of US\$500 million.

H&T Battery Components is a producer of deep drawn cylindrical cans for the consumer battery industry. H&T Waterbury operates in a 128,000 square foot plant located in Waterbury, Conn employing 120 employees, and did business as Bouffard Metal Goods, Inc. prior to a name change in 2006. H&T's total investment of \$10 million, subsidized by the \$5 million award, will be used to expand manufacturing capabilities for new battery technologies and increase employment at the Waterbury Connecticut site. In addition to its Connecticut facility, H&T Battery Components has manufacturing plants in Germany, China and Singapore. H&T Waterbury is proud to be a part of this rapid expansion of US based battery manufacturing infrastructure.

NASA to Evaluate International Battery's Lithium-Ion Large Format Batteries


International Battery, a US manufacturer, designer and developer of large-format lithium-ion rechargeable cells and batteries, has announced that NASA has awarded International Battery a contract to build a battery prototype that will provide backup power in support of the space shuttle program.

NASA is interested in International Battery's large-format, high energy density, prismatic cells that provide advanced energy storage along with the company's comprehensive Battery Management System (BMS). The BMS is specifically designed for large format cells and provides increased safety and performance through individual cell monitoring and continuous cell balancing. The entire system is being deployed as an uninterruptible power supply (UPS) to maintain backup power for critical ground operations.

"This opportunity to partner with NASA further validates International Battery's truly large format technology," said International Battery's CEO, Ake Almgren. "Our individual cells are ten to fifty times larger than those commonly labeled 'large format' today. Employing fewer cells to store the same quantity of energy lowers the cost of integrated battery systems and improves reliability and performance."

The added feature of International Battery's environmentally-friendly, water-based manufacturing process is of additional significance to NASA. International Battery is currently the only company in the US that can produce lithium batteries using a

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water-based process. This method does not require solvents and eliminates the need for a costly disposal process.

The battery prototype will be tested at Kennedy Space Center by the end of 2009 and targeted for implementation at other space centers after successful integration and testing efforts have been achieved.

The company's Allentown, Pa., factory is the first purpose-built commercial manufacturer of next-generation large-format lithium ion batteries in the US, and is helping to reverse the offshore flow of manufacturing capability.

EnerG2 Awarded \$21.3 Million in Federal Stimulus Funds

EnerG2 has been awarded \$21.3 million in Federal stimulus funds allocated for makers of advanced automotive batteries and energy storage technologies.

The funds will be used to help build the first facility in the world dedicated to the commercial-scale production of nano-engineered synthetic high-performance carbon electrode material. This material is an important ingredient in ultracapacitor energy storage devices, which are used in electric and hybrid vehicles.

EnerG2 will partner with Oregon Freeze Dry, a current manufacturing partner, in the construction of the facility in Albany, Oregon. OFD will bring deep experience and expertise to the project and will help accelerate the benefits that the plant will bring to the automotive industry.

"We appreciate the Department of Energy's confidence in us," said Rick Luebbe, CEO of EnerG2, "and we are eager to help the next generation of clean transportation become a reality. We are confident that our materials will improve these vehicles' efficiency, range and affordability."

EnerG2's approach to energy storage centers on customized electrode materials that enhance energy and power density in ultracapacitors, one of the essential engines of our clean-technology future.

Ultracapacitors store and release more energy faster than conventional batteries. The size and make-up of the electrodes' surface area helps ultracapacitors store and supply large bursts of energy; the materials also effectively enable limitless cycle life for the device.

ENER1 and Volvo Cars Team-Up to Provide Lithium-Ion Power for the New C30 Battery Electric Vehicle

ENER1, Inc., developer and manufacturer of lithium-ion batteries to power the next generation of hybrid, plug-in hybrid and pure electric vehicles, is teaming-up with Volvo Car Corp. to provide American-made lithium-ion batteries for the Volvo C30 Battery Electric Vehicle prototype. The battery is designed and developed in the US by EnerDel, Inc., Ener1's US battery subsidiary. This follows the recently announced collaboration with Volvo on the plug-in hybrid V70 demonstration vehicles being road tested in Europe this fall, which also feature EnerDel lithium-ion batteries.

The C30 Battery Electric Vehicle is part of Volvo Car Corp.'s DRIVE Towards Zero Strategy and is a mobile test bed proving that through intelligent packaging and technology, a pure electric vehicle can be great to drive while not compromising on factors such as luggage space and interior comfort.

It is designed as a zero emission, city commuter car covering the day-to-day mobility needs of more than 90 percent of European commuters. The 95 mile range and packaging efficiency of the vehicle is derived in a large part from the highly efficient lithium-ion battery, designed and manufactured by EnerDel, who produces some of the highest energy density battery cells in the world. The EnerDel battery for the C30 battery electric vehicle (BEV) is custom made and is a 'split battery', with an energy content of over 24 kWh nominal energy, of which 22.7 kWh is used to power the car.

"We are delighted to be partnering with Volvo again on this exciting development project which aims to test the technical solutions of a full Volvo battery electric vehicle, in the highly desirable Volvo C30," said Ulrik Grape, presi-

dent, Ener1 Europe. "We are developing a close working relationship with Volvo and are collaborating intimately on integration of the battery and safety in these advanced vehicle concepts."

The new project follows a series of announcements from Ener1 in the last month including the appointment of a new president for EnerDel and a further strengthening of the senior management team, the creation of a new European Division, acquiring a leading shareholder position and securing a long term supply contract with Think Global, and being selected to receive a \$118.5 million in Federal Grant Funding to double production capacity in the US.

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Developments in the Battery Market: An Overview

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

Batteries form the energy source for most key equipment in day-to-day life. This makes batteries one of the essential elements in everyone's life. However, most consumers are not always aware of the various battery chemistries powering different equipment. Every chemistry is unique and is efficient for a specific application. In a world with an increased usage of sophisticated gadgets with high power demand, developments and advancements form the base for the right evolution of batteries that help make life better. This article discusses some of the key developments and advancements in battery construction and design process that make them much more efficient.

Developments and advancements in battery design and manufacturing process occur in almost all battery chemistries. Enhanced battery chemistries could offer better performance and efficiency in their end-user application. Discussing the developments occurring in each of the battery chemistries and the impacts on their end-user application could give a clear view on the developments in this market.

Lead-Acid Battery Chemistry

This is the oldest chemistry dating back to the 19th century; it did not witness any major evolution for more than 100 years until the 1970s. During the 1970s, modification to the electrolyte was completed from a liquid electrolyte to a gel type and absorbed glass matt (AGM) type. This gave rise to three different types of lead-acid batteries, opening large avenues for the application of this chemistry. Lead-acid battery chemistry still generates the largest revenue, accounting for nearly 40 percent of the total global battery market revenues.

This chemistry is used in major industrial, backup and automotive applications. It is witnessing a revamp from 2008 and is one of the chemistries competing in the effort to develop the best suited and most efficient batteries for hybrid electric vehicles (HEVs) and electric vehicles (EVs). Some of the most dynamic advancements in this battery chemistry include the development of UltraBattery for which the US Government has awarded \$32.5 million announced as part of the federal stimulus bill to EastPenn Manufacturing Company. This funding could increase the production capacity of these batteries.

UltraBattery is a combination of a supercapacitor and lead-acid battery in a single unit. Importance is given to this development mainly because of its features that offer a life cycle that is at least four times longer and produces 50 percent more power than conventional battery systems, along with the advantage of being 70 percent cheaper than the currently available batteries used for HEVs.

Similarly, Firefly Energy, Inc. is a noteworthy participant in this chemistry, having altered the key electrodes of lead-acid batteries and improved the energy density and performance almost four to five times that of regular lead-acid batteries. Axion Power International, Inc., another significant contributor to this market, developed lead-acid batteries using patented lead carbon technology. This advancement generated interest and curiosity in the industry, which resulted in Axion Power receiving a funding of \$800,000 for testing and demonstrating these lead-acid batteries in HEVs and EVs. This advancement was impressive and promising, which attracted Exide Technologies (one of the global leading lead-acid battery manufacturers) to work in joint venture with Axion Power to develop these lead carbon technology-based batteries for alternative vehicles. A key advantage of these advancements is that these lead-acid batteries make HEVs and EVs affordable, thereby increasing the unit volumes of vehicles across the world. This could reduce the gasoline usage and hazardous emissions to the atmosphere.

The advanced form of thin metal-film (TMF) technology has used lead-acid chemistry as well. Development of lead-acid thin-film batteries by Bolder Technologies Corp. (a group company of GP Batteries from Asia) makes lead-acid batteries a handy power source with the advantage of being lightweight. These advancements in lead-acid battery chemistry is similar to an effort that makes a reliable, proven chemistry getting prepared for competing aggressively with relatively new chemistries.

Lithium-Ion Battery Chemistry

Lithium-ion is the most popular chemistry in the current environment, which has its focus on environmentally friendly alternative vehicles. Lithium-ion batteries refer to a collection of different batteries that have lithium as the common anode, and cathodes differ from cobalt oxide to manganese or phosphate depending on the application in which these batteries are employed. The power of lithium-ion batteries has doubled since its launch in 1991. Advancements in lithium-ion batteries are much attributed to

making efficient packing of electrodes and electrolytes through thin separators within the layers. The thinner the separator, the thinner the dimension of the battery cell. This chemistry finds consistent development with a focus on altering the cathodes to suit the demand for a specific application. For instance, cobalt cathode is suitable for consumer electronics such as mobile phones and laptops as it offers high energy at a steady pace. However, phosphate or manganese is more suitable for power tools, HEVs and EVs as these cathodes could offer sudden burst of high power.

Extensive research is being made in this chemistry to develop a safe, efficient, lightweight, and consistent-performing battery that is suitable for all applications. Lithium-ion batteries revolutionized the consumer electronics market, replacing nickel cadmium and nickel metal hydride batteries to a large extent. Similarly, it is the most expected battery chemistry, which is likely to be the key for wide spread utilization of HEVs and EVs.

Other Chemistries Witnessing Remarkable Advancements

Other chemistries that are widely focused for research include zinc-air, silver-zinc and zinc-bromine. ZPower, Inc. is one of the significant manufacturers developing silver-zinc rechargeable batteries that could potentially challenge the existence of lithium-ion batteries for consumer electronics applications. Silver-zinc batteries offer almost 40 percent more power than lithium-ion batteries with the advantage of being safe to use and environmentally friendly.

Similarly, ReVolt Technology is a significant manufacturer in the zinc-air market, which is working to develop zinc-air batteries for alternative vehicles and energy storage systems. This advancement could offer an alternative environmentally friendly solution to the existing old chemistries, which are heavier than these new developing technologies.

The zinc-bromine battery is also an emerging chemistry using zinc as one of the electrodes. This chemistry is focused on the energy storage application that is currently dominated by the lead-acid battery chemistry. ZBB Energy Corp. is one the significant manufacturers involved in this chemistry, developing the complete solution of Zinc Energy Storage System (ZESS) using zinc-bromine batteries. The advanced flow battery technology would make zinc-bromine batteries of ZBB suitable for plug-in HEVs and EVs as well.

Apart from these established chemistries, few other battery chemistries are under trial in laboratories and are yet to be developed and tested. This chemistry involves the rechargeable

battery developed with salt and cellulose. With raw materials for this chemistry being so inexpensive, the end product (battery cell) is affordable for almost every consumer and has the advantage of being environmentally friendly and completely recyclable. However, this concept is still in the laboratories of universities and takes a long time to become commercially available.

Another interesting battery chemistry which is under development in the laboratory of MIT is the liquid battery. A unique concept of this battery is the presence of electrode and electrolytes all in its liquid form poured in a container. The difference in energy density separates them and offers satisfactory performance in the laboratory. This is another emerging chemistry which is in concept stage that is yet to be ready for commercialization.

Thin-Film Battery Technology

TMF is a separate category of batteries that are gaining commendable importance in recent years. These are batteries in which the electrodes and electrolytes are embedded in a single sheet and are available in paper thickness. This technology has revamped the concept of battery shapes being cylindrical or rectangular utilizes most of the commonly available chemistries such as carbon zinc, nickel cadmium, and most prominently lithium-ion.

Availability of TMF batteries has helped the electronics segment to advance further. As these are the key power sources for RFID tags and micro equipment that are typically used for spying and sensing applications. Although very few companies such as Infinite Power Solutions, Inc., Enfucell Ltd, Cymbet Corp. and Exelletron Solid State LLC, to name a few, are involved in this category. Potential for this technology is enormous.

Battery chemistries and the battery market have greatly evolved. Except one or two mature chemistries, almost all other chemistries are undergoing significant advancements that make them fit to compete for the increased future demand. Battery manufacturers understand that this is a continuous evolution process, so the focus has been on research and development activities to improve their products. Hence, the tier 1 vendors focus on research and development to improve their existing battery products to emerge as a highly competitive market.

Contact Frost & Sullivan at www.Frost.com.

"Except one or two mature chemistries, almost all other chemistries are undergoing significant advancements that make them fit to compete for the increased future demand."

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17-19

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25-27

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30- Dec 4

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Boston, Mass.

December

7

2nd Battery & Fuel Cell Hybrid Systems
Orlando, Fla.

2010

February

2-5

1st European Advanced Automotive Battery Conference
Mainz, Germany

March

15-18

The 27th International Battery Seminar & Exhibit
Fort Lauderdale, Fla.

May

17-19

BATTCON International Stationary Battery Conference
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17-21

10th International Advanced Automotive Battery Conference
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