

ENERDEL/ARGONNE ADVANCED HIGH-POWER BATTERY

APPLICATIONS

- Hybrid electric vehicles
- Electric vehicles
- Plug-in hybrid electric vehicles
- Ideal for military and aerospace markets
- Deep-drilling technology
- Global Positioning Systems
- Biomedicine -- implantable implantable medical devices

BENEFITS

- Safest lithium-ion battery available
- Better performance than lithium-ion batteries
- Cost-effective to produce and operate
- Excellent low-temperature performance
- Compact design
- Lighter in weight than current nickel-metal hydride batteries
- Longer battery life than current nickel-metal hydride batteries -- as long as 15 years

STATUS

- 2008 Winner, R&D 100 Award
- On March 24, 2008, Argonne and Toda Kogya of Japan announced an agreement regarding licensing of Argonne's patented electrode materials for the commercial production and sales of lithium-ion batteries.
- EnerDel has entered into a \$70 million contract with Think Global of Oslo, Norway, to supply Think Global with batteries over a two-year period.

New Battery Outperforms Current Batteries in HEV Applications

Overview

Escalating energy costs are dramatically boosting the popularity of hybrid electric vehicles (HEVs) across the world, but particularly in developed countries, such as the United States, United Kingdom, and Japan. In spite of growing demand, technological, performance, and safety limitations associated with nickel-metal hydride (Ni-MH) and lithium-ion (Li-ion) batteries used in powering these vehicles are impeding their market growth.

To overcome these limitations, Argonne researchers and their colleagues from EnerDel (Indianapolis, IN) have developed a lithium-ion (Li-ion) battery that is lighter in weight, occupies less space, provides more power and energy, and has a longer life than the nickel-metal hydride batteries found in today's hybrid electric vehicles. And, it outperforms its lithium-ion battery competitors.

The patented battery technology is suitable for all applications that require high-power, low-temperature performance, high-temperature storage, and long calendar life.



The EnerDel/Argonne Advanced High-Power Lithium-Ion Battery was successfully integrated into an operating Toyota Prius, which was shown to run well with the battery.

Outstanding Performance, Innovative Design

Not all Li-ion batteries are created equal. The EnerDel/Argonne advanced high-power Li-ion batteries are more advanced than any competing lithium-ion batteries for HEVs — and yet they represent the safest Li-ion battery technology on the market. Key to this innovative technology is unique spinel (a hard crystalline mineral) materials used in the cathode and anode.

LINKS TO ONLINE INFORMATION

http://www.anl.gov/techtransfer/Available_Technologies/Battery_Technology/index.html

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ABOUT ARGONNE TECHNOLOGY TRANSFER

Argonne National Laboratory is committed to developing and transferring new technologies that meet industry's goals of improving energy efficiency, reducing wastes and pollution, lowering production costs, and improving productivity. Argonne's industrial research program, comprised of leading-edge materials research, cost-saving modeling, and unique testing and analysis facilities, is providing solutions to the challenges that face U.S. manufacturing and processing industries.

Outstanding Performance, Innovative Design (continued)

The battery's cathode consists of lithium manganese oxide spinel, LiMn_2O_4 (LMO), which is a very attractive cathode material because of its low cost, outstanding power capability, and stability. The battery's anode consists of high-ionic-conductivity $\text{Li}_4\text{Ti}_5\text{O}_{12}$ (LTO), which consists of nanoparticles that are less than 15 nm. This innovative LMO/LTO design makes industrial processing easier and safer.

Best-in-Class Safety

Argonne's LMO/LTO system provides the safest Li-ion battery chemistry available today. The unique chemistry of the Argonne/EnerDel Li-ion battery eliminates the need for expensive battery management and cooling systems, thereby reducing cost while improving battery safety. Safety is also important during assembly and maintenance, because the high voltage conditions (>100 V) that exist in HEV battery packs can pose potential hazards for workers and auto mechanics.

Excellent Cycle Life Characteristics

Tests of the LMO/LTO system show that even under a severe charge and discharge cycle at high temperature, the capacity of the LMO/LTO cell remains very stable with no loss in energy storage capability after 2,800 cycles. This long cycle life has never before been reported for any Li-ion battery system and shows the stability of the EnerDel/Argonne system, which can provide a battery with at least 15 years of life.

Lower Cost

The EnerDel/Argonne LMO/LTO battery system offers significantly lower cost than NiMH batteries and comparable other lithium-ion battery systems. Because power is more important than energy capacity in HEVs, a more powerful system means that a smaller and lighter battery can provide the power required to propel an HEV. As a result, manufacturers can significantly reduce the amount of material in a battery across the board, significantly reducing cost.

Ideal for Vehicle and Other Applications

The EnerDel/Argonne batteries will remove the remaining barriers now inhibiting consumer acceptance of HEVs. In addition to application in HEVs, the batteries are ideal for electric vehicles and plug-in hybrid electric vehicles. In fact, by using the new batteries, consumers will be able to receive an immediate return on their investment in terms of fuel cost savings — and help reduce America's dependence on foreign oil while slashing harmful emissions.

Beyond the automotive sector, markets for the battery technology include military, aerospace, and asset tracking applications. The batteries can operate at high temperatures, so they are suitable for any high-temperature applications that require stability, such as implantable batteries that must operate for 20 years at a human body temperature of 37°C.

