

## LI-ION BATTERIES WITH LONGER LIFE, LOWER COST, AND BETTER SAFETY

### ARGONNE'S INTEGRATED R&D PROGRAM ADDRESSES

- Increased operating time
- Increased power
- Increased calendar life
- Reduced cost
- Improved safety
- Improved energy density

### THROUGH ADVANCES IN:

#### CATHODES

- Higher capacity (up to 270 mAh/g), with high voltage compatibility and greater stability
- Improved current capability, environmental compatibility and stability at lower cost

#### ANODES

- Higher capacity (up to 2000 mAh/ml)
- Materials that are safer than graphite and have greater life
- Improved stability.

#### ELECTROLYTES

- Polymeric electrolytes that have high ionic conductivity, enhanced safety, larger cell capacity and improved voltage stability
- Additives that provide reduced gas generation and first cycle capacity loss plus longer life and enhanced safety

#### PACKAGING

- Flexible packaging that provides lower cost and improved shape control
- Nanocomposite material that provides extended life in flexible packaging

#### SAFETY

- Advanced additives that provide improved flame retardancy and stabilized electrode surfaces

Argonne National Laboratory is developing advanced cell components that will enable new market applications for lithium-ion (Li-ion) batteries. This technology promises to play an important role in expanding the medical, transportation and portable device battery markets.

Lithium-ion batteries offer significant advantages in weight and energy density over other rechargeable batteries. They have proven to be ideal for small-scale portable electronic applications such as cellular phones and laptop computers. Emerging applications in implantable medical devices also take advantage of the high cycle life, light weight and other benefits of Li-ion batteries.



20-cell 80-volt 8-kW Li-ion battery module designed by ANL for Hybrid Electric Vehicle Application

### Burgeoning Market for Materials Suppliers

Because of the unique features of Li-ion technology, the market for Li-ion batteries has become substantial, not only for the cells and batteries, but also for the raw materials that go into the cell components. Argonne is internationally recognized for its expertise in developing and testing innovative battery materials. The Argonne intellectual property portfolio for Li-ion technology has over 30 pending or issued patents, with additional inventions presently under consideration for patent applications.



