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Can anything tame the battery flames?

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Ross Dueber, CEO of Zinc Matrix Power, has two words for you: think zinc.

The Camarillo, Calif.-based start-up is one of a number of companies that has been toiling away at a problem that's no longer obscure due to Dell's massive laptop battery recall: Lithium ion batteries can, under the right conditions, explode into flames.

"They (lithium ion batteries) contain a highly flammable liquid in a pressurized vessel. They have a fairly powerful oxidizer. You've got to have strict quality control in manufacturing," he said. "It's the only rechargeable battery technology has uses a flammable liquid."

By contrast, Zinc Matrix has come up with a silver zinc-based battery that can't explode, according to Dueber. The materials inside the battery--mostly zinc, zinc oxide and water--aren't flammable. Notebooks running on these batteries, which will go into low volume production in early 2007, can last eight to ten hours, he asserted, longer than lithium.

Lithium ion batteries, which came out in 1990, are the surly child prodigy of portable electronics. These batteries can hold far more energy than conventional rechargeable batteries and generally weigh less than traditional rechargeables. Notebook makers and cell phone manufacturers have used these properties to create fairly light devices that can run for several hours on a single battery charge.

Unfortunately, a short circuit inside a lithium ion battery can lead to what's known in the industry as a "runaway thermal reaction." The reaction can cause the battery case to melt and spew hot liquids, or explode due to pressure and heat. Injuries have been reported around the globe.

To make matters worse, manufacturers have continued to increase the energy density--or the amount of energy the battery can hold--of lithium ion batteries by thinning out separators (which keep the electrodes apart) and changing other components. These changes lead to longer run times--something consumers are demanding-- but also raise the potential that something can go wrong.

"The root cause is more and more energy required in a limited volume. You aggravate the safety issues," said Rick Cooper, vice president of business development at PolyFuel, which makes membranes for direct methanol fuel cells.

For the past several years, venture capital firms have been putting money into start-ups promoting technologies that replace, or supplement lithium ion batteries. To date, most of the interest has been

around trying to improve battery life and run time in portable electronics.

Cooper and others, however, have said that safety is now one of the primary concerns among hardware makers. In turn, safety could help spur adoption.

Many of these alternative technologies have also faced delays or not been adopted when expected. Most of the time, it's because early versions of the alternative technologies have not worked as well as lithium ion. Historically, for example, zinc batteries didn't recharge well. Nonetheless, momentum, say these companies, is growing. MTI Micro Fuel Cells is producing fuel cell prototypes for Samsung. Zinc Matrix, meanwhile, has received $32 million in venture funding since 1999. It is currently building a pilot manufacturing facility and has lined up Tyco Electronics to help it move to mass manufacturing.

Circumstances have also changed to make the market potential more favorable for these non-lithium technologies. Late last year, for instance, the United Nations passed a resolution permitting passengers to carry methanol into checked luggage on airplanes. Regulatory bodies in different nations are expected to pass rules allowing passengers to carry methanol in carry-on bags in 2007.

Methanol is flammable, Cooper acknowledged, but methanol fuel cells don't provide the same explosive potential. The methanol is kept in an unpressurized container and it is stored away from the hot components in a computer.

Cooper also added that fuel cells will complement, but not replace, lithium ion batteries. Notebooks will have both: The lithium ion will kick in for tasks that require lots of energy, like graphic-intensive games. The fuel cell will run the computer during low-impact tasks like word processing. Still, a notebook rigged with a fuel cell will be able to be equipped with a much smaller lithium battery.

Lithium ion manufacturers have also known for some time that the opportunities for improving the performance of their products were limited.

"The theoretical maximum will be reached by 2006 for lithium ion chemistry," said Hammed Cadbury, product marketing manager for the energy component group at Sony in an interview in 2004.

Controlling lithium

Despite the explosive potential, lithium batteries are enjoying popularity in electric and hybrid cars. The Tesla Roadster, an all-electric sports car, runs on a battery containing 6,831 lithium ion cells, said CEO Martin Eberhard.

Safety precautions, however, are taken to the nth degree in the car. The lithium ion cells are all isolated from each other, so that if one catches fire, the fire won't spread to other cells. In that event, sensors also detect the fire and shut down the battery and let the driver coast to a stop.

The battery is also cooled and kept at around 25 Celsius. This doesn't prevent failure, but allows the lithium ion cells to live longer despite several recharges.

Eberhard further added that the company has placed stringent quality standards on its lithium ion cell suppliers. "We aren't buying the cheap ones," he said.

Valence Technology, meanwhile, has come out with a lithium battery for modifying hybrid cars that reduces the risk of failure. The company's U-Charge Power System contains a cathode material, the metallic pole inside a battery that attracts electrons, made of metal phosphate. Most lithium ion batteries sport a cathode based around cobalt.

Batteries with the metal phosphate can store only about 75 percent of the energy a traditional lithium ion battery can hold. However, the phosphate won't burn. In traditional lithium ion batteries, heat inside the battery can cause the cobalt oxide cathode to decompose.

While Valence has mostly sold to vehicle makers, Bogues earlier this year predicted that the safety issue could bring notebook makers to the company's door.

"At some point, some company will push for safer batteries," he said during an interview in June.