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New Batteries Readied for GM's Electric Vehicle

The technologies behind the battery packs for the GM Volt are being tested and could be ready within a year.

By Kevin Bullis

This week, General Motors (GM) announced its selection of battery makers to develop and test battery packs for use in its proposed electric vehicles. The selected battery makers, Compact Power, based in Troy, MI, and Continental Automotive Systems, based in Germany, say that they've overcome the performance and cost limitations that have been an obstacle to electric vehicles in the past.

Over the next 12 months, researchers from, Compact Power, Continental Automotive Systems and GM will be testing the battery-pack designs in the lab and in vehicles to confirm that the packs can work for the life of the car--at least 10 years, says Denise Gray, director of hybrid energy storage devices at GM. Initial tests of individual battery cells, along with projections about the performance of battery packs that can contain hundreds of these cells, have Gray optimistic that her company will have proven packs by June 2008.

If the packs perform well, they are slated for use in the proposed Chevrolet Volt, an electric concept car announced by GM in January. The Volt marks a change in emphasis for GM, which previously focused on more distant plans to bring hydrogen-fuel-cell-powered cars to market. The Volt could be ready within a few years. Until now, however, it has been unclear who would develop its advanced batteries.

There are a number of design variations for the Volt, but they will all be propelled by electric motors. In one version, the battery pack, which can be recharged by plugging it in, will provide 40 miles of range. Then an onboard gasoline- or ethanol-powered generator will kick in to recharge the battery, providing an additional 600 miles of range. A proposed hydrogen-fuel-cell version would have a smaller battery pack and no onboard generator.

To make batteries that are up to GM's specifications, battery makers have had to redesign the chemistry of lithium-ion batteries, a type of battery widely used in mobile phones and laptops. While lithium-ion batteries are light and compact, the type of lithium-ion battery typically used in electronic devices relies heavily on cobalt, an expensive metal. The cobalt oxide used in one of the battery's electrodes isn't thermally stable, making the batteries prone to bursting into flame if damaged or poorly manufactured--a shortcoming that led to the massive recall of millions of laptop computer batteries last year. (See "Safer Lithium-Ion Batteries.") This could be a problem in vehicle battery packs, which would be much larger than those in portable electronics, so an accident could be more dangerous.

One alternative is to replace cobalt with manganese. Mohamed Alamgir, director of research at Compact Power, says that manganese-oxide electrodes are significantly more thermally stable than cobalt oxide, and less expensive. The battery maker has also developed a new material for keeping the electrodes separate: the material remains stable at higher temperatures than conventional materials, further guarding against the runaway heating that causes batteries to catch fire. What's more, the company makes the batteries in a flat shape rather than in the typical cylindrical design. Alamgir says this flat shape prevents heat from building up at the center of the cell, making it easier to keep the battery at an even, cool temperature.

A123 Systems, a company based in Watertown, MA, that will supply battery cells to Continental, has taken a different tack, turning to an iron-based cathode that is even more thermally stable than manganese oxide. Better still, iron is cheap and abundant. (See "More Powerful Hybrid Batteries.") The electrodes are not oxide materials but phosphates, a chemistry that more closely binds oxygen, preventing it from being freed from the material, which would allow the battery's flammable electrolyte to catch fire. Such materials do not allow for fast charging or delivery of big bursts of power, so researchers modified them, in part by doping the material and by forming the material as nanoparticles. The A123 batteries were developed for use in power tools but have since been modified to store more energy, making them better suited for use in electric vehicles such as the Volt.

The battery packs for the Volt must include complex electronics for ensuring that each cell is charged and discharged properly. If individual cells are overcharged, for example, the pack can fail. Unlike measuring the gas in a tank, it can be tricky to monitor the exact amount of charge in a cell. So battery makers often include more cells to provide a margin of safety, as a hedge against both running out of power and overcharging the batteries. The pack makers are developing better electronic equipment and algorithms for measuring charge, which could allow them to use closer to the bare-minimum number of cells.

Even as the new battery packs are being tested, GM is developing the rest of the vehicle, especially making sure that it meets targets for weight. Ultimately, Gray says, there could be tradeoffs between vehicle weight and battery size, depending on how the tests go. There's even a chance that expectations for the battery pack's lifetime could be lowered if necessary, although she emphasizes that the goal now is to have battery packs with 10-year lifetimes.

In June 2008, after analyzing the data from a year of testing, GM will evaluate if the technology is where it needs to be and pick a production supplier, Gray says.