

Power of technology makes future a reality



Remember when cell phones were as big as bricks and seemed just about as heavy to lug around? What helped them shrink to today's sleek proportions was the 1991 debut of a slim and lightweight new energy source: the rechargeable lithium-ion battery. Today, this mighty mite powers a host of small, new-age devices – cell phones, MP3 players, laptop computers and the like. If only it could power something as big and demanding as a car.

ExxonMobil's battery separator film helps propel the all-electric Maya-300.

Soon it will, thanks to research and development being carried out by ExxonMobil Chemical and Tonen Chemical, a Japan-based company affiliate that played a key role in the introduction of the first commercial lithium-ion battery two decades ago. Together, they've advanced a critical battery component – the separator – that's set to boost both the energy efficiency and the power of hybrids and electric vehicles. In December, ExxonMobil unveiled the innovative technology in Anaheim, California, at the Electric Vehicle Symposium, an annual forum showcasing hybrid, electric and fuel-cell vehicles.

Separator film plays big role

In the makeup of the lithium battery, the separator is one of the key internal layers. Made from plastic film, it separates positive electrodes from negative electrodes to prevent short circuits. It also shuts down the battery's flow of electricity if it overheats. But conventional separators that perform reliably in lithium-ion batteries in little cell phones are less likely to be up to the job in bigger versions designed for cars. ExxonMobil overcame this barrier by developing a separator film that increases the safety margins and power of the battery.

Most of today's hybrid and electric vehicles still run on yesterday's heavy nickel-metal-hydride batteries. Their size and weight can be reduced, and performance increased, by replacing them with lithium-ion batteries, as has already happened in portable electronics and cordless power tools.

In 2004, ExxonMobil launched a determined effort to put battery technology for hybrid and electric vehicles on the fast track, so to speak. Hybrid vehicles run on motors powered by alternating fuel types – typically gasoline and electricity. “The challenge was, how could we make a separator film that would work safely and reliably in a battery that has to run at the very hot temperatures inherent in these kinds of vehicles?” says ExxonMobil Chemical Senior Vice President Jim Harris.

The company found the solution in a marriage of new product and process technologies. At its Baytown, Texas, laboratories, ExxonMobil Chemical used its product-design experience to develop high-heat-resistant polymers, while Tonen Chemical advanced a film-manufacturing process that combines multiple polymers into a single ultra-porous sheet that's thinner than a human hair. The result of their collaboration is a proprietary separator film that not only improves

safety performance and reliability but also boosts the flow of electricity and extends battery life. Moreover, the advanced film can be custom-designed to the specifications of individual battery makers.

"It's been exciting for us to develop a film that allows compact, lightweight lithium-ion batteries to deliver higher power and run safer at the same time," says ExxonMobil chief polymer scientist Pat Brant, who led the research team.

Film in production to meet demand

The new separator film is already in production at Tonen Chemical's manufacturing plant in Nasu, Japan. "We've been providing test samples to several battery manufacturers and independent laboratories, and we're helping them conduct commercial evaluations," says Andrew Malkin, president of Tonen Specialty Separators. Already the world's second-largest producer of separator film, Tonen Chemical is poised to quickly scale up production of the new product to meet growing sales. In anticipation of longer-term demand growth, the company is looking at building a second separator films plant in Gumi, South Korea. A government testing center is also planned to be built to evaluate advanced battery systems for hybrid vehicles and other uses.



Electrovaya's Maya-300, shown here on the streets of Toronto, is designed for city driving.

Harris predicts that electric and hybrid cars and light trucks may be running on lithium-ion batteries within the next two years. “We have already seen the first commercial launch of an electric vehicle that uses ExxonMobil’s battery separator film. In January, Electrovaya introduced the Maya-300, which is a low-speed vehicle with a range of up to 120 miles and designed for urban and neighborhood driving patterns.”

ExxonMobil has long been committed to improving energy efficiency and reliability, and lowering processing costs and emissions at its refineries, chemical plants, production and other facilities through a variety of technologies and operational improvements. The company’s advanced fuels, lubricants and specialty products are designed to help engines run cleaner and more efficiently as well. So the supply of specialty films for hybrid vehicles is consistent with these initiatives.

“It’s one of a number of research and development efforts we’ve undertaken in the interest of making vehicles more fuel efficient,” says Harris. “We continue to collaborate with automakers and engine manufacturers on advanced engine-and-fuel concepts.”

Last year, ExxonMobil introduced a synthetic lining material that reduces weight and helps tires maintain proper air pressure, both important in cutting fuel consumption. The company is developing new technologies to improve the efficiency of internal combustion engines by up to 30 percent. It is also developing an onboard hydrogen generation system that can be used in a fuel-cell vehicle to improve fuel economy by 80 percent and reduce greenhouse gas emissions by 45 percent, compared to today’s vehicles using conventional fuel.

Effort boosts efficiency, cuts emissions

“Improving batteries for hybrid and electric vehicles is consistent with these and other long-standing efforts to promote energy efficiency and emissions controls across all our operations and products,” says Harris.

According to independent researchers J.D. Power and Associates, U.S. sales of hybrids reached nearly 355,000 vehicles last year – about 2 percent of the automotive market – as more motorists made buying choices with fuel economy in mind. Hybrid sales are expected to grow to 1 million vehicles, or 6



percent of the U.S. market, by 2012. Worldwide sales of hybrid vehicles are expected to rise as well.

“If ExxonMobil’s film separator can reduce the costs and weight of battery systems, then hybrids could become more than a niche market,” said Erich Merkle, vice president for forecasting with automotive research firm IRN, in the Houston Chronicle in November 2007. “Quite honestly, that’s the type of thing that’s going to make hybrids much more practical.”

“This is what the future looks like,” Harris concludes, “and we want to be part of it. It will take a company with our depth of technological and investment resources to help make that future a reality.”