

Nickel-Metal-Hydride Batteries — High Energy Storage for Electric Vehicles

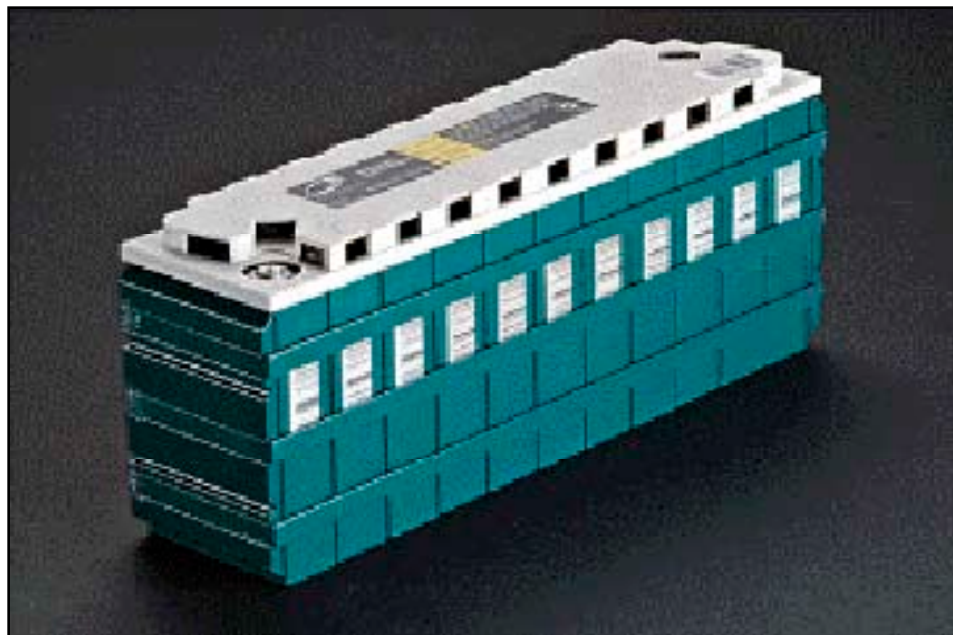
Background

The key to making electric vehicles (EVs) practical is the development of batteries that can provide performance comparable with that of conventional vehicles at a similar cost. Most EV batteries have limited energy storage capabilities, permitting only relatively short driving distances before the batteries must be recharged.

In 1991, under a cooperative agreement with The U.S. Department of Energy (DOE), the United States Advanced Battery Consortium (USABC) initiated development of nickel-metal-hydride (NiMH) battery technology and established it as a prime mid-term candidate for use in EVs. DOE funding has been instrumental to the development of NiMH technology at two manufacturers, ECD Ovonic and Saft America. DOE national laboratories have provided critical testing and evaluation of NiMH prototypes, as well as identification of potential failure mechanisms.

The Technology

During the past decade, NiMH batteries have proved themselves in laptop computers, cellular phones, video cameras, and other products in



use worldwide. But adapting NiMH technology for EV application has been challenging for battery developers because of the need to provide EVs with the same performance as conventionally-powered vehicles at a significantly lower cost per unit of energy compared with the smaller consumer batteries. Battery developers have had over 100 years of experience working with lead acid technology, whereas NiMHs were invented just 12 years ago. These and other factors explain the high cost of the new batteries, which at pilot production levels still are several times more expensive than USABC's commercialization cost target.

Commercialization

In the mid 1990s, DOE national laboratories evaluated more than 35 NiMH modules and 3 full-size EV batteries for further development. The success of NiMH batteries attracted the attention of General Motors Corporation (GM) and DaimlerChrysler to evaluate the use of these batteries in their own EVs. GM was so pleased with ECD Ovonic's NiMH technology that in 1994, GM and Ovonic Battery Company formed a manufacturing joint venture, GM Ovonic, to commercialize NiMH batteries for EVs. GM subsequently incorporated GM Ovonic's NiMH batteries in more than 400 of its 1999 model



EV-1 cars and S-10 pickups; driving range was doubled for both vehicles. Cobasys, LLC, a joint venture between ECD Ovonic and Chevron Technology Ventures, LLC, will provide their advanced NiMHax® NiMH battery system to GM for use in the 2007 Saturn Vue Green line.

EC/s is also licensing its technology to several other battery manufacturers including Sanyo, which supplies NiMH batteries for the Ford Escape and Honda Accord; and Panasonic, which supplies batteries for Toyota hybrid electric vehicles.

In 1997, DaimlerChrysler announced its decision to equip its Electric Power Interurban Commuter with NiMH batteries made by Saft, which marks the first use of NiMH batteries in a mini-

van. The Saft NiMH battery helped reduce the weight of the minivan by 150 pounds and increased its driving range up to 150 km. Both manufacturers are now working on the production of second-generation NiMH batteries.

Benefits

- An EV displaces approximately 450 gallons of petroleum per year.
- Well-to-wheels energy efficiency is nearly double that of conventional vehicles.
- EVs produce zero tail-pipe emissions
- Batteries are made of non-toxic materials and are 100% recyclable.
- Battery lifetime expectancy is over 100,000 km

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