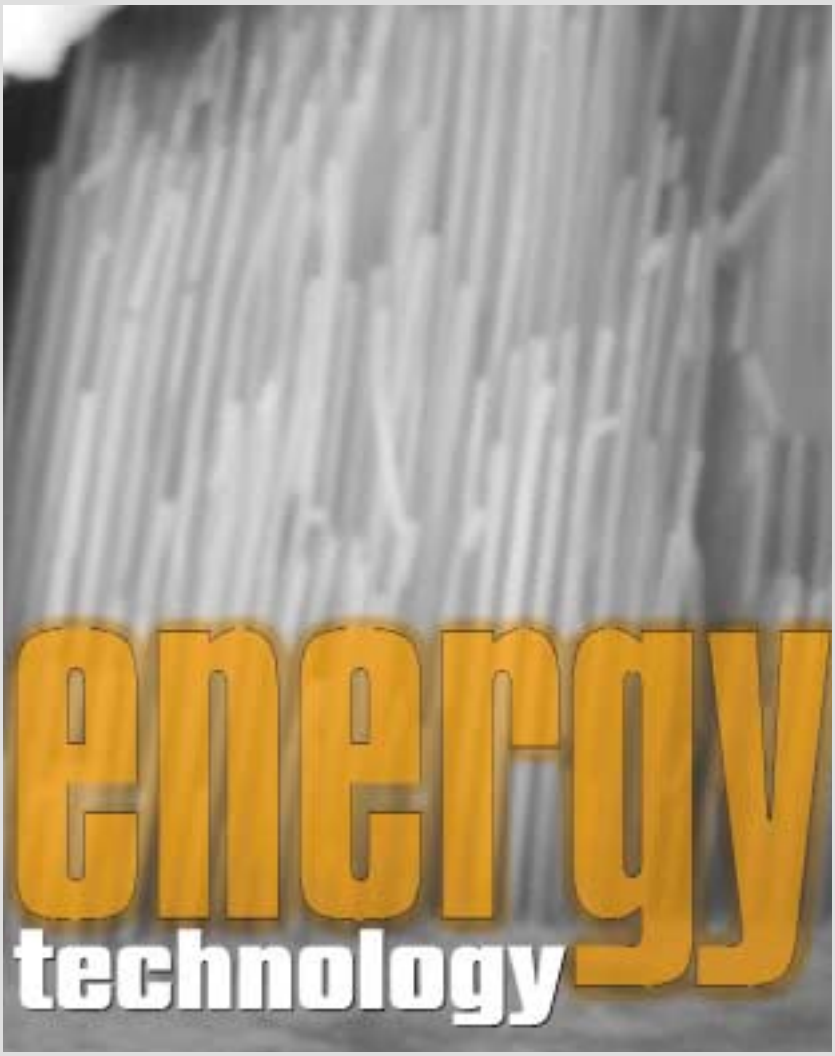
Energy Technology Division



The Energy Technology Division

by Tom Fuller

Energy technology is the science and technology of energy conversion and storage. The mission of the Energy Technology Division (ETD) is to encourage and stimulate research and development on new and existing technologies that will improve efficiency, reduce energy use, lower costs, and result in a cleaner environment. Within the Society, the focus is clearly on electrochemical methods of energy conversion and storage. These include fuel cells, photovoltaics, thermoelectric devices, supercapacitors, and the like.

Energy storage and conversion are as essential today as at the time of the energy crisis when the Division was first begun, or at the turn of the century when the Society was formed. Although The Electrochemical Society focuses on the electrochemical aspects of energy technology, its activity is clearly and profoundly driven by technologies outside of electrochemistry. Decades after the Energy Crisis, fossil fuels are still king. For example, more than half of the electricity generated in the United States today comes from coal. Electrochemical systems for energy conversion are slowly entering the market, but costs are still high, limiting acceptance.

Historically, one of the difficulties with alternative-energy technologies has been the low price of fossil fuels. Many business models have relied on decreasing prices with increasing demand. As the prices of alternative energy sources decreased, the thinking went that demand would increase, leading to significant market penetration. Implicit in most models was the assumption that the price of oil and other fossil fuels would increase dramatically; to date this has not occurred. As a result, acceptance of many of these technologies has been slower than expected. Nonetheless, the future looks bright—it is not a question of whether, but rather when for many of these new technologies. Until the cheap supply of fossil fuel is exhausted, the major driver for much of the technology is efficiency and emissions, *i.e.*, largely environmental. The exceptions are the applications

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that are less sensitive to price, such as space and defense.

One such application is discussed in the first of two articles in this issue related to energy technology. This is "Thermal to Electric Power Conversion Using Thermoelectric Micro-convertors," by Amy Ryan and J.-P. Fleurial. These devices convert thermal energy to electrical energy based on the Seebeck effect. The application is for exploration of the outer planets where one cannot depend on solar energy. The second article is on hybrid systems. In many applications of fuel cells, batteries, and other energy storage and conversion devices, hybrids are the systems of choice. This is because there is a need to provide high power density briefly and also maintain high energy density and efficiency. Walt van Schalkwijk and Michael A. Kepros discuss hybrid power devices and how they can be used to meet these needs.

Areas that are not represented in detail are photovoltaics and fuel cells, cornerstones of the Division. Everyone is familiar with one type of photovoltaic device, the solar cell, which converts solar energy into electrical energy. Although the rate of energy that is radiated to earth from the sun is vastly larger than the energy being used from all sources, solar cells still generate only a tiny fraction of the world's electrical demand. Nonetheless, photovoltaics are finding more and more applications and demand is growing, particularly in Japan and Europe. Replacing relatively expensive silicon with a conducting polymers is one active area of research to reduce costs.

Fuel cells are still inching their way to widespread introduction and true commercialization. In spite of the relatively slow progress, the prospects have never looked better. Today there are a number of companies pursuing fuel cells. In the proton exchange membrane (PEM) technology, nearly every major automotive OEM and other fuel cell developer are collectively investing hundreds of millions of dollars annually. The primary drivers are of course emissions and efficiency.

Four UTCFC PC25 fuel cell power plants provide the main power for a critical data processing facility at the First National Bank in Omaha, Nebraska. The bank is one of the largest credit card processors in the nation. Prior to installing the back-up power system, a major retailer lost millions of dollars in sales during one brief power outage.

Whereas most stationary fuel cell applications still rely on fossil fuel, transportation and many portable applications will most likely use hydrogen. Although fuel-cell systems are much simpler with hydrogen, no infrastructure exists today to provide hydrogen readily, and the amount of energy stored per unit of volume is low compared to liquid hydrocarbon fuels. A key enabler of these hydrogen systems is improved hydrogen storage, which is being actively researched. We are also beginning to see signs that the fuel-cell industry is moving from research and development to commercialization. Numerous professional organizations have begun to develop codes and standards for stationary and transportation fuel cells. These include JAMA (Japanese Automobile Manufacturers Association), and SAE (Society of Automotive Engineers), for example. DuPont advertised "fuel cells" during the Super Bowl in January of this year, and fuel cell centers and institutes are springing up at many major universities, such as the University of Pennsylvania, the University of Connecticut, Georgia Institute of Technology, and the University of California at Irvine. The photograph above, of a phosphoric acid uninterrupted power system (UPS) recently installed in a commercial building, exemplifies the type of role that fuel cells are likely to play in the energy requirements of tomorrow.

Energy issues permeate every aspect of every day life. The electrical power shortage in California last summer, and the chronic instability in the Middle East are reminders that significant changes are certain. The Energy Technology Group was formed in 1976, in part in response to heightened awareness following the energy crisis, and it became a Division in 1987. Since 1994 the Energy Technology Division has granted a research award roughly biennially. J. R. Selman and I. Uchida were the 2001 recipients for their work in molten carbonate fuel cells. The Division has grown steadily in the past two decades and it is clear that much of the present success of the ETD may be credited to the original founders and past officers, many of whom are still active today. Their efforts have been instrumental in ensuring a robust and healthy Division that will respond to the changing needs of society as a whole. ■

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