Fuel Cells and Energy Storage Systems

"Cost and durability are major challenges to fuel cell commercialization and achieving a hydrogen economy." -- Department of Energy

One of the leading innovators in fuel cell research in Pennsylvania is Professor of Mechanical Engineering and Materials Science and Engineering, Chao-Yang Wong. Wong is the director of the Electrochemical Research Center (ERC), which conducts fundamental and applied research on fuel cells and advanced batteries for electric propulsion, stationary power generation, and portable electronics. The ERC's work includes the development of water management and the assessment of fuel cell technology.

Because of their advanced materials requirements, fuel cells are at the interface between energy and materials. Wong's research focuses on the interplay between these two fields, a role he says is similar to that of both the ERC and the Materials Research Institute at Penn State. "The work we do in energy storage and conversion systems, such as batteries, are integrated into the larger picture of energy and materials science. Understanding the nuances of these materials is essential in our research." Wong explains. "Both systems are based on electrochemical principles, so they are clean and efficient. At the same time, materials play a major role in both systems."

Recent efforts to scale up to full-sized fuel cells have been challenging. "We are trying to develop a high-performance fuel cell that will be able to generate power for a long time," Wong says. "Our goal is to create a system that can operate for extended periods of time." This requires a detailed understanding of the materials, the electrochemical processes, and the overall system design.

Batteries and fuel cells for transportation

Hybrid electric vehicles are already widely commercialized, with over 230,000 units sold in the US in 2006. Most automakers have a hybrid vehicle program of some sort that is beyond the R&D stage. A major requirement for hybrid electric vehicles is a reliable, long-lasting electrical storage system. The battery's capacity is a significant factor in determining the vehicle's range.

Battery technology is evolving rapidly, with new materials and designs being developed to improve performance, reduce costs, and increase energy densities. "We are working on developing batteries that are both cost-effective and capable of delivering high performance," Wong says.

Dr. Wong in lab

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The Nissan Leaf is a fully electric vehicle that is currently being developed by Nissan. The Leaf is designed to provide a range of up to 100 miles on a single charge. "We are working on developing batteries that are both cost-effective and capable of delivering high performance," Wong says. "We are also working on developing new materials that can improve the energy density of batteries."}

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