Introduction to Completed Project Reports

Six GCEP research projects have reached completion this May 2008 in the areas of Hydrogen Production, Distribution and Use, Renewable Energy-Solar, and Renewable Energy-Biomass.

Professors Anders Nilsson, Bruce Clemens, and Hongjie Dai formed an interdisciplinary team of faculty that conducted research into reversible hydrogen storage on carbon nanotubes. They resolved a long-standing debate in the literature over how much hydrogen can be adsorbed onto high surface-area, nanostructured carbon substrates.

In the area of hydrogen production, distribution, and storage, Professors Jonathan F. Stebbins and Fritz B. Prinz studied solid-state NMR of oxide ion conducting ceramics for enhanced fuel cell performance. The goal of this work was to provide mechanistic understanding of fundamental processes in fuel cells in order to optimize their performance sufficiently to allow them to take a role as key elements in future hydrogen-based energy systems.

In this same area, Peter M. Pinsky, and David M. Barnett carried out modeling, simulation and characterization of atomic force microscopy measurements for ionic transport and impedance in PEM fuel cells. They developed a theoretical framework to model electrostatic force microscopy measurements on conductive and dielectric samples, i.e. fuel cell electrolyte materials. This framework will allow the development of inverse algorithms for solving charge distributions form images, allowing assessment of a certain fuel cell design.

In the area of Renewables-Solar, Michael D. McGehee completed a project on nano-structured photovoltaic cells, where the goal was to understand the operating mechanisms in organic solar cells and to use this knowledge to improve their efficiency. These studies have resulted in several design rules that are now being used by many to make more efficient organic solar cells.

Also in the area of Renewables-Solar, Fritz B. Prinz, and Arthur M. Grossman, carried out studies to determine if bioelectricity is possible and economically feasible. The project focused on exploring the possibility of drawing electricity directly from a biological cell with unicellular alga cell and spinach organelles as the focus. Nano-scaled electrodes were inserted into cellular structures to measure light-induced oxidation and reduction currents.

In the area of Renewables-Biomass, Chris Somerville completed a project aimed at obtaining enhanced biomass through increased cellulose accumulation. The goal was to test the hypothesis that cellulose deposition is controlled at the level of gene expression by placing the genes of cellulose synthase under control of an inducible promoter in the model plant, *Arabidopsis.*