Lawrence Livermore's Joe Wong

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DOE Pulse

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Research Highlights . . .

Sorting out proteins

With more and more protein sequence data available, scientists are increasingly looking for ways to extract the small subset of information that determines a protein's function. In addition to sorting out what makes related proteins differ, such information can help scientists engineer proteins to do new jobs. Now scientists at Brookhaven Lab have written a computer program to sort the informational "wheat" from the "chaff." The program identifies positions where two related groups of proteins differ in amino acid identity or in a property such as charge or polarity—positions likely to be biologically important for defining the proteins' specific functions.

[Karen McNulty Walsh, 631/344-8350, kmcnulty@bnl.gov]

Pushing the limits of high-temperature sensors inside nuclear reactors

As engineers worldwide develop materials for the next generation of nuclear reactors, DOE's Idaho National Laboratory is preparing to test these components under normal and accident conditions. Tracking high temperatures in a test reactor has always been difficult. Existing sensors, called thermocouples, lose their accuracy either from high temperatures or from radiation that causes sensor components to transform into other elements. Selecting different materials for wires, insulators and sheaths, INL's High Temperature Test Laboratory developed a thermocouple that can withstand temperatures 500 degrees Celsius higher than existing sensors. Preliminary test results were presented in November at the American Nuclear Society's winter meeting.

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Argonne research helps improve permanent magnets

Permanent magnets are important in a variety of commercial technologies, from car starters to computer hard drives. Researchers at DOE's Argonne National Laboratory have found clues to making those magnets longer-lasting and more powerful. Using the Advanced Photon Source X-rays, the researchers were able to see details of rare-earth ions, a critical component of permanent magnets. Probing their magnetism with unprecedented resolution revealed that the presence of rare-earth ions in more than one atomic environment reduces the magnetic stability of the best-performing permanent magnets to date. This knowledge will enable manufacturers to manipulate the rare-earth ion atomic structure for optimization of future magnets.

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Double jeopardy: CDF seeks doubly-charged Higgs bosons

The CDF experiment at DOE's Fermilab is searching for a long-lived, doubly-charged Higgs boson, which deposits four times the "ionization energy" of the typical singly-charged particle. Ionization energy occurs when a charged particle traverses a gas, stripping electrons from atoms and turning them into ions. While no candidate events have yet been found, CDF has set the best limits in the world on the pair-production of long-lived doubly-charged Higgs bosons: 133 GeV and 109 GeV, respectively, on the masses of long-lived doubly-charged Higgs bosons with left-handed (H_L) and right-handed (H_R) interactions. If H_L and H_R have the same mass, CDF's lower mass limit increases to 146 GeV. The search continues.

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DOE Pulse highlights work being done at the Department of Energy's national laboratories. DOE's laboratories house world-class facilities where more than 30,000 scientists and engineers perform cutting-edge research spanning DOE's science, energy, national security and environmental quality missions. DOE Pulse is distributed twice each month. For more information, please contact Jeff Sherwood (jeff.sherwood@hq.doe.gov, 202-586-5806).

NETL Facilities Paving the Way Toward a Hydrogen Economy

National Energy Technology Laboratory's efforts in fuel cell research and development are bringing into focus DOE's vision of cleaner, more efficient energy production. Recent developments at three NETL facilities are moving this alternative energy technology toward commercialization and leading us into a hydrogen economy.

High-temperature fuel cells being promoted by NETL utilize both hydrogen and carbon monoxide to create electricity by a virtually pollutant-free, electrochemical process. This technology operates on a variety of fuels (pure hydrogen, natural gas, or coal) to efficiently generate electricity on demand and on location, offering appealing power choices for commercial entities.

Bringing this alternative technology to the general market is a comprehensive undertaking, and two NETL facilities are taking the lead. The Solid Oxide Fuel Cell Experimental Laboratory (SOFCEL) and the new DOE Fuel Cell (DFC) testing facility contribute design research and evaluation results to theSolid State Energy Conversion Alliance (SECA), whose ultimate goal is to commercialize low-cost, solid oxide fuel cell (SOFC) systems.

NETL's SOFCEL investigates SOFC fundamentals and has made advances in understanding the root causes of fuel cell degradation. New tools for fuel cell designers, such as high-temperature strain gauges, are also being developed. These and other SOFCEL research developments will improve the understanding of fuel cell operation and contribute to the optimal design of SECA's fuel cell technology.

As SECA develops SOFC prototypes, independent performance testing and evaluation must occur—and NETL's DFC fulfills this requirement. DFC researchers are currently using a 5-kilowatt SOFC system supplied by Acumentrics, a SECA industry team, to evaluate and calibrate the testing facility, which can accommodate up to a 10-kilowatt fuel cell system. Plans call for at least one SECA prototype system to be brought to the DFC in 2006 for testing and evaluation. NETL's program managers will utilize testing results to assess the progress of SECA's manufacturing partners toward achieving overall SOFC cost and performance goals.

Of course, NETL is already planning next-generation, large-scale energy solutions—solutions that build on SECA's SOFC development. Creating a bridge to the hydrogen economy, SECA technology will serve as the building blocks of zero-emission power plants, like FutureGen, when integrated into high-efficiency hybrid systems.

A third NETL facility, the Hybrid Performance Project (HYPER), examines the operability of such fuel cell/gas turbine hybrid systems combining actual turbine hardware and computerized simulations of fuel cell models. HYPER has achieved successful start-up of the system without stalling, which can otherwise cause high-dollar damage to real fuel cell stacks. The facility is also addressing fuel cell response to transient events and evaluating related control strategies to aid in the development of appropriate design and operational parameters for future hybrid systems.

The benefits of fuel cell technology are already recognized, and the challenges facing researchers and designers are being conquered each day. Without question, the transition to a hydrogen economy has begun, and NETL's unique fuel cell facilities provide the support needed for this national—even global—energy transformation.

Submitted by DOE's National Energy Technology Laboratory

Joe Wong took a long road to Livermore

When Joe Wong looks back on his life, he's convinced his children don't know much about the first 27 years of his life. That was life before he was married, had three children, two grandchildren and long before he started working in the Chemistry and Materials Science Directorate at DOE's Lawrence Livermore National Laboratory.

Joe Wong

Born in Hong Kong, Wong traveled a round-about way to get to Livermore in 1986. At 17, he left Hong Kong to attend high school in Australia and earned two bachelors degrees from the University of Tasmania.

He went on to work in Australia and worked nights as a lecturer at Royal Hobart College, in Tasmania. He then attended Purdue University in the United States and was recruited by GE Research and Development Center.

But one-third of the way through his career, Wong changed his specialty; he was fascinated by synchrotron radiation. He helped build the first X-ray beam line at Brookhaven Lab. At the same time, Livermore was working with Stanford to construct three beam lines for Lab programs. He soon had a job offer from Lawrence Livermore.

In 2003, Wong's Livermore team mapped the full phonon dispersions of plutonium using an innovative micro-beam-on-single-grain technique, ending the quest of this fundamental data for the past four decades or so.

Wong has come a long way from his studies in Tasmania. And by the time his stint at Livermore is over (he retires Jan. 4), he will have published more than 200 papers, earned 7 patents, and garnered more than 12 awards from two R&D 100 Awards to the Alexander von Humboldt Research Award for Senior U.S. Scientists. Most recently, Wong was awarded a 2005 fellow of the American Physical Society

Submitted by DOE's Lawrence Livermore National Laboratory