The Fossil Report

Oak Ridge National Laboratory Fossil Energy Program

Fall 2001

Energy Technology for the Future...and for the World

ORNL Proposal Winner in Recent Competition

An Oak Ridge National Laboratory proposal was one of the winners in the recent DOE Laboratory solicitation for research and technology to bring methane hydrates into the natural gas resource base and ensure safe drilling operations in and around hydrate occurrences.

The proposal, *Mesoscale Characterization of Natural and Synthetic Gas Hydrates*, was submitted by **Claudia J. Rawn** of ORNL's Metals and Ceramics Division.

It is anticipated that this research, through a deeper understanding of the physical properties of natural and synthetic gas hydrates, will form the basis for developing working models of hydrate stability relevant to global climate change, greenhouse gas sequestration, development of clean-burning fuels, and exploration and recovery of fossil petroleum fuels.

It is envisioned that the results of this research will guide decisions for the safe and economic production of natural gas from

See Winner - page 2

Claudia Rawn is a Research Staff Member in the Diffraction and Thermophysical Properties Group where she studies the crystal structure, phase transitions, and thermophysical properties of materials using in-situ X-ray and neutron diffraction.

She received her B.Sc. from Virginia Polytechnic Institute and State University in Materials Engineering in 1986, her M.Sc. from George Mason University in Chemistry in 1991, and her Ph.D. from the University of Arizona in Materials Science and Engineering in 1995.

Between 1987 and 1992, Claudia worked in the Ceramics Division of the National Institute of Standards and Technology as a Materials Research Engineer studying the phase equilibria of high T_c superconductor systems. After completing her Ph.D., she was a Postdoctoral Research Associate in the Ceramics Department of the **Joñef Stefan Institute** in Ljubljana, Slovenia, where her research responsibilities included single crystal growth and solid state synthesis of samples for single crystal X-ray diffraction and X-ray and neutron powder (Rietveld) structural refinements, respectively. She joined the Metals and Ceramics Division at ORNL in 1997 as a participant on the Oak Ridge Associated Universities Postdoctoral Fellowship Program.

During her career, she has co-authored over 40 technical publications and is active in a number of professional organizations, serving on several committees.

IN THIS ISSUE

ORNL Proposal Winner in Recent Competition
Latest on FY 2002 Appropriations
Lehigh University Researcher Wins Awards
New Research to Benefit Coproduction Plant Concept
NETL Unveils Methane Hydrate Web Site
Liu Wins Distinguished Award
Prototype Fuel Cell Uses Diesel Fuel

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The Fossil Report **is published quarterly.**

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Winner from page 1

natural gas hydrate deposits.

Knowledge of the physical and chemical properties of gas hydrates is critical. The resolution of production issues, such as the location and quantity of natural gas hydrate deposits, the sediment-hydrate relationships, the process of gas release (and, conversely, the process of CO_2 inclusion), and the mitigation of hydrate formation in pipelines depend on a clear understanding of both the physical and chemical nature of these materials.

The experimental methodology will be developed to characterize structural and interfacial properties of natural gas hydrates on a mesoscopic length scale. Mesoscopic refers to dimensions intermediate between macroscopic and atomic dimensions.

These studies will contribute to the accumulation of information for reliable evaluation of various hydrate recovery schemes and assessments and predictions of seafloor stability.

*This work is supported **DOE Office of Fossil Energy, National Energy Technology Laboratory**.*

*For more information on this work, contact **Claudia Rawn**, Oak Ridge National Laboratory.*

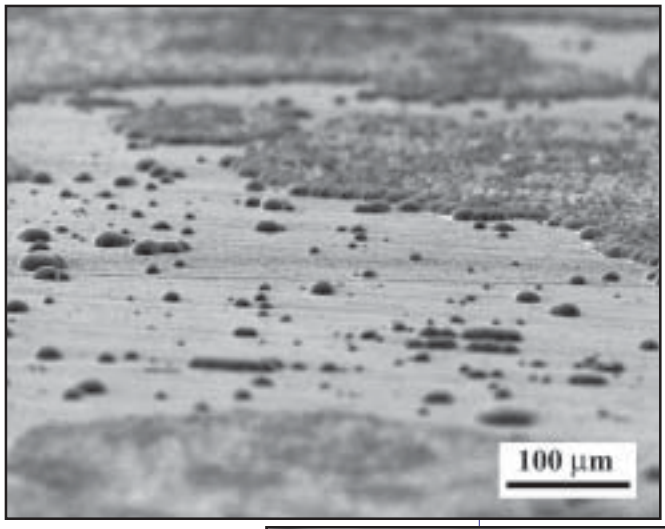
Lehigh University Researcher Wins Awards

Jonathan Regina, a graduate student at Lehigh University and a participant on the Fossil Energy Advanced Research Materials Program, was awarded a first place for his entry to the 2001 International Metallographic Contest, sponsored by **American Society for Metals International** and the **International Metallographic Society**.

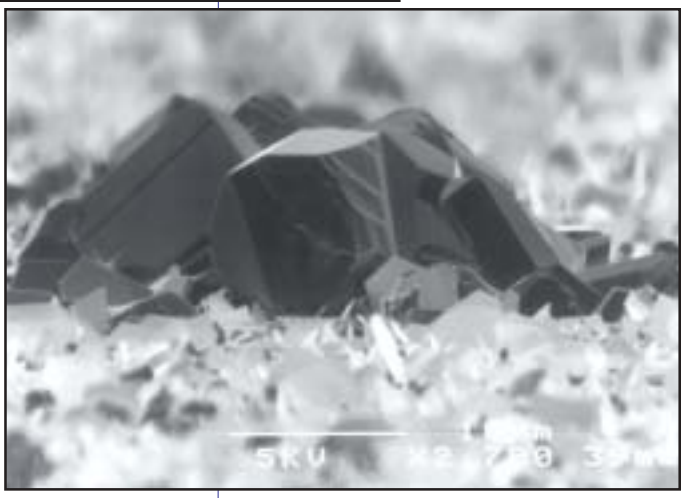
His poster "Passive Layer Breakdown During High Temperature Corrosion," won a first place in the Scanning Electron Microscopy category.

Jon also placed first in the Artistic Black and White category for his photograph entitled "Mount Olympus."

Jon, in pursuit of a Ph.D., and his advisors, Professors **Arnold Marder** and **John DuPont**, are involved in research for the Advanced Research Materials Program, investigating the effect of chromium on iron aluminide weld overlay coatings for corrosion protection in fossil-fired power plants, operating with low-NO_x burners.



From Poster: "Passive Layer Breakdown During High Temperature Corrosion"



Mount Olympus

Latest on FY 2002 Appropriations

The Interior and Related Agencies Bill, which, when enacted, provides appropriations for Fossil Energy research and development activities, was signed by President Bush and became **Public Law 107-63** on November 5.

The Conference Committee Budget, cleared for the White House on October 17 and presented to The President on October 25, may be found in **summary** and **detailed** tables on the DOE Fossil Energy Web site.

NETL Unveils Methane Hydrate Web Site

The DOE **National Energy Technology Laboratory** has developed a very informative Web site on the **National Methane Hydrate R&D Program**.

The site contains the latest developments in hydrates research, a primer on the science of methane hydrates, a description of the Government's activities in hydrates research, and links to other organizations involved in methane hydrate R&D.

The Methane Hydrate Data Bank, containing technical information on worldwide resources, and the Interagency Coordination Plan will be available at this site in the near future.

Burning Hydrate Photo, courtesy National Energy Technology Laboratory

New Research to Benefit Coproduction Plant Concept

A consortium of Texaco, Praxair, General Electric, and Kellogg, Brown and Root is in the process of developing a new concept of combining integrated gasification combined cycle and **Fischer-Tropsch** synthesis technologies to improve process efficiency by the coproduction of clean electric power and Fischer-Tropsch diesel fuel.

The project was developed as part of the DOE's **Early Entrance Coproduction Plant concept.**

The feedstock, petroleum coke, for the gasification process has a low hydrogen-to-carbon ratio, and the synthesis gas combustion products have a different composition than that of a typical gas turbine exhaust stream.

A gas turbine fueled with natural gas yields an exhaust gas with approximately three percent carbon dioxide. By comparison, the exhaust gas from a turbine fueled with synthesis gas derived from petroleum coke, combined with the off-gas from the Fischer-

See Coproduction - page 4

Liu Wins Distinguished Award

Chain Liu, a researcher on the ORNL Fossil Energy Program, was presented with a Distinguished Award at the THERMEC 2000 International Conference on Processing & Manufacturing of Advanced Materials.

Distinguished Awards are given to those scientists who have made outstanding contributions in the field of advanced materials.

Liu's citation was specifically for "for innovative and outstanding contributions in the field of intermetallic materials."

Liu and co-principal investigator **Mike Brady** perform research on the Advanced Research Materials Program on intermetallic reinforced Cr alloys.

Courtesy, **M&C Pipeline**, *Summer/Fall 2001*

Prototype Fuel Cell Uses Diesel Fuel

Researchers at the **University of Pennsylvania** have developed a prototype fuel cell which operates on ordinary diesel fuel, opening the door to a new generation of fuel cells—and a new viability for this important energy source.

Work to develop commercial fuel cells has been hindered by the limited fuel sources on which they are capable of operating.

The prototype fuel cell, developed by Professors Raymond J. Gorte and John M. Vohs, along with graduate student Hyuk Kim and postdoctoral researcher Seungdoo Park, is smaller than a penny and operates in a furnace at 700 C.

A commercial, self-contained fuel cell, however, would generate that heat itself, using the fuel placed in it.

The prototype fuel cell is the first to run directly on hydrocarbons, without requiring complicated reforming into hydrogen—either within the device itself or at specialized filling stations.

Generating electric power through controlled electrochemical reactions, rather than combustion, means that its only emissions are water, carbon dioxide, and heat.

David Bauer, team leader for the Solid Oxide Fuel Cell project at the Ford Research Laboratory commented that they are "excited by the progress that Professor Gorte and his colleagues are making in the area of direct oxidation of hydrocarbon fuels using solid oxide fuel cells."

Bauer added that "The ability to utilize conventional fuels with little or no reforming is particularly important in transportation applications where fuel storage and system packaging are such critical issues."

The U.S. military regards fuel cells as a possible source of "portable power" for soldiers carrying electronic devices.

In a partnership with Honeywell, the University of Pennsylvania has recently been awarded a $1.8-million contract by the U.S. Army and the Defense Advanced Research Projects Administration to develop a coffee-can-sized fuel cell capable of generating power equivalent to 50 D-cell batteries.

The military is particularly interested in the prototype, because of the reduced tendency for explosion, owing to the lower vapor pressure of diesel fuel.

*This article is excerpted from an story in **Science Daily**, adapted from a **University of Pennsylvania** news release.*

"Great harm has been done to us. We have suffered great loss. And in our grief and anger we have found our mission and our moment. Freedom and fear are at war. The advance of human freedom — the great achievement of our time, and the great hope of every time — now depends on us. Our nation — this generation — will lift a dark threat of violence from our people and our future. We will rally the world to this cause by our efforts, by our courage. We will not tire, we will not falter, and we will not fail. "

President George W. Bush
Address to a Joint Session of Congress and the American People
September 20, 2001

Coproduction from page 3

Tropsch synthesis process, contains about 9.5% carbon dioxide.

Oak Ridge National Laboratory has developed a physical adsorbent called the Carbon Fiber Composite Molecular Sieve that has been shown to be effective in separating CO_2 from a wide variety of gas streams via the process of physical adsorption.

Moreover, because the material is electrically conductive it may be efficiently regenerated by the passage of an electric current at low voltage. This is the focus of the recently-patented Electrical Swing Adsorption Process.

Tim Burchell and his team at Oak Ridge National Laboratory will be contributing to the consortium through modifications to, as well as potential new developments for, the current Carbon Fiber Composite Molecular Sieve. The objective is a version of the CFCMS capable of removing CO_2 from the exhaust gas of a turbine of the type envisioned by the consortium.

Over the next several years, it is hoped that the research will result in an optimization of the CFCMS to achieve a reduction of the CO_2 concentration in the turbine exhaust stream from 9.5% to approximately 350 ppm, the latter representing atmospheric concentration.

Determinations will be made of the CFCMS capacity limit for the adsorption of CO_2 from the turbine exhaust gas and of the kinetics of CO_2 adsorption and desorption under Electrical Swing Adsorption Process conditions, relevant to the turbine exhaust gas.

The long-range vision of the work is a manufacturable CO_2 removal system, based on the CFCMS, for inclusion in an operating coproduction power plant.

*This work is jointly funded by **DOE Office of Fossil Energy, National Energy Technology Laboratory** and Texaco Energy Systems, Inc..*

This article was excerpted from a narrative prepared by Tim Burchell, Oak Ridge National Laboratory.

*For more information about this research, please contact **Tim Burchell.***