

NETL-RUA Outstanding Colleague: University of Pittsburgh Professor Bill Harbert

It is a rare day that you *don't* see [Bill Harbert](#) in the halls of Building 84 at NETL in Pittsburgh, exuding a passion for his research and a commitment to the NETL-RUA mission. His emphasis on an integrated team approach to his work, his valued contributions to on-going research, and his commitment to student development are just a few reasons he is such an esteemed contributor to the work of the Alliance. Department chair and professor of Geophysics at Pitt, Bill is currently leading research efforts on six NETL-RUA projects. He also serves as the NETL Strategic Monitoring Group Lead for the National Risk Assessment Partnership (NRAP). Bill's research focuses on seismic imaging of carbon dioxide (CO₂) and petrophysics measurements conducted at the Geological Sequestration Core Flow Lab at NETL. Work in the Core Flow Laboratory is under the direction of Dr. Yee Soong of NETL and Dr. Igor Haljasmaa of URS. Recent efforts have led to eight presentations at the American Geophysical Union Fall and CCUS-12 meetings during the past year.



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E News is your monthly source for the latest information about NETL-RUA's research, activities and other important news. If you have information that you would like to feature in future newsletters, send that information to

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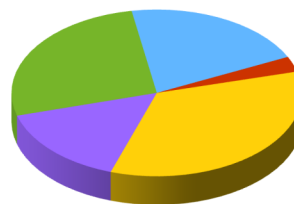
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NETL-RUA METRICS SNAPSHOT

PRODUCTS		
	FY2011	FY2012
Publications	194	43
Patents	11	2
Licenses	9	4
Students Graduated	20 PhD	9 PhD
	8 MS	6 MS

RESEARCH PERSONNEL



Total = 537

- Graduate Students - 111
- Undergraduate Students - 16
- University Researchers - 184
- URS Researchers - 83
- NETL Researchers - 143

Products data is updated quarterly

June 2012

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Bill first came to NETL as an [Oak Ridge Institute for Science and Education](#) (ORISE) research associate in 2002. Following his ORISE appointment, he served as an Institute Fellow with the Lab's Institute of Advanced Energy Solutions (IAES), the predecessor of the NETL-RUA. He has authored or co-authored 60 peer-reviewed publications, one textbook, and was an associate editor of *Paleogeodynamics: The Plate Tectonic Evolution of the Earth*, published by the American Geophysical Union. In addition to his work in geophysics, Bill also holds research associate status at the Carnegie Museum of Natural History and adjunct faculty status in the Center for Russian and Eastern European Studies at Pitt.

Chris Purcell, one of the University of Pittsburgh PhD candidates under Bill's expert tutelage, has recently defended his work entitled "Ultrasonic velocity measurements using super critical CO₂ and other pore fluids, and integration into 4D reflection seismic imaging." Chris's research work in the NETL-RUA effort has enabled him to complete his PhD and landed him a position with the firm Nexus Geosciences, an advanced seismic imaging and subsurface uncertainty solutions company.

According to NETL's Brian Strazisar, "Bill has been a key leader in facilitating research across multiple institutions within the NETL-RUA. We've come to recognize him more as a key member of the NETL-RUA scientific community than as a member of the Pitt faculty. He's

been a great example of success in the building of seamlessly integrated teams that are truly representative of the vision of the NETL-RUA." Brian serves as technical coordinator on several of Bill's NETL-RUA projects.

Mentoring Energy Leaders of Tomorrow

The development of energy leaders of tomorrow is a key component of the NETL-RUA program. Besides Chris Purcell, representative graduates of the active NETL-RUA collaborative research program around Bill include Dr. Brian Lipinski, now with Chevron, and Dr. Vladislav Kaminski, who has formed his own company, PromiseLand Exploration. This company focuses on mineral and rare earth electromagnetic geophysical exploration. Dr. Kaminski also maintains a position at the Geophysical Inversion Facility at the University of British Columbia. Two other energy-related geology researchers developed through the NETL-RUA are Ms. Erica Love, a munitions response scientist IV/Geologist at Tectra Tech NUS, and Dr. Fouzan A. Alfouzan, Assistant Research Professor, King Abdulaziz City of Science and Technology, Oil and Gas Research Institute.

Committee Update

At the quarterly Executive Committee meeting held on May 2, the NETL-RUA Manager presented a request from several standing committees for clarity and guidance on governance, growth strategies, and goals; information that the committees are seeking to make their efforts more effective and ensure that the ultimate vision will be achieved. In response to this feedback, the Executive Committee directed the committee chairs to temporarily suspend meetings while it evaluated the current position of the NETL-RUA, developed consensus on a path forward, and jointly set targets and goals for the NETL-RUA.

Over the summer, the Executive Committee will be addressing a variety of topics to include the strengths of the NETL-RUA that can be leveraged, the role of industry in the Alliance, a governance structure for effective decision-making, management and resourcing of efforts, methods

to enhance collaboration, flexibility versus responsibility within the site support contract structure, expectations for growth (goals, target areas ripe for investment, proactive strategies), and pursuit of educational initiatives. This strategic planning effort will culminate in a facilitated discussion at the next quarterly Executive Committee meeting scheduled for August 29, 2012. As a demonstration of their commitment, the Executive Committee has agreed to employ a facilitator with the knowledge and skill to drive these discussions to inclusive solutions and sustainable agreements such that the end result is more clear guidance to the NETL-RUA members on vision and the strategy for achieving it.

Committees are asked to meet if a need arises, but otherwise can remain on hiatus until guidance is provided from the August Executive Committee meeting.

Advanced Materials Will Increase Gasifier Availability

The heightened interest in cleaner energy systems makes gasification-based technologies among the strongest of the emerging power generation options. Integrated gasification combined cycle (IGCC) based power stations combine the advantages of relatively inexpensive fuel with the efficiency and environmental performance of systems such as gas turbines and fuel cells, provided that contaminating sulfur can be removed efficiently. Synthesis gas (syngas)—a mixture of hydrogen and carbon monoxide—is also easily cleaned of most contaminants, and because gasification is a closed process, it is easily adapted to carbon capture and storage technology. The interest in cleaner systems has led NETL-RUA researchers Tetsuya Kaneko and Sridhar Seetharaman from Carnegie Mellon University (CMU) and James Bennett from NETL to dedicate themselves to improving gasifier performance by increasing gasifier on-line availability. The work is focused specifically on developing improved refractories—heat-resistant materials—and controlling refractory/slag interactions.

The gasifier is the key component of an IGCC facility. It is a high temperature, high pressure containment vessel used to convert carbon feedstock into syngas. Types of carbon feedstock used in gasification include coal and/or petcoke, with biomass now also being considered as a potential feedstock material. Impurities in carbon feedstock materials vary from about 1 to 10 percent and liquefy during gasification (1325–1575 °C), forming slags that interact with the ceramic refractory liner, causing chemical corrosion and spalling. These forms of refractory degradation lead to unpredictable and premature shutdown of a gasifier. It is essential that gasifiers operate at temperatures high enough for the slag to flow out, yet as low as possible to reduce refractory corrosive wear.

Moreover, when mixtures of carbon feedstock (coal, petcoke, and/or biomass) are used in a gasifier, molten ash is formed, generally with poorly known chemistry and properties. The ash has unknown interactions with the refractory liner, also causing unpredictable refractory service life.

Refractory liners containing a high proportion of chrome oxide are used to protect gasifier shells. They typically last from 3 to 36 months with current coal and petcoke feedstock and depending on the gasifier site, feedstock materials used, quantity of feedstock material converted per unit time, and the general environment of the gasifier. The research being carried out at NETL in collaboration with CMU is aimed at understanding the reactions and mechanisms that are critical for gasifier operation, and center on (i) studying the corrosion of the refractory liners and how the molten ash slag properties influences this corrosion, (ii) measuring the slag properties, and

(iii) modeling of these processes. Recent results highlight how slag infiltration can be limited through the formation of reaction products at the slag/refractory surface or by the increased viscosity of the infiltrating slag as it penetrates down the temperature gradient (**Figure 1**).

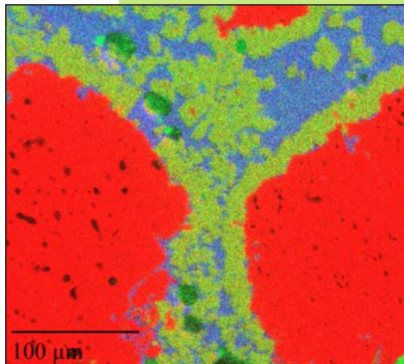
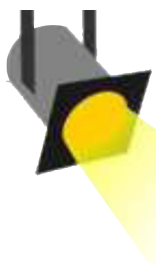


Figure 1: Energy Dispersive Spectroscopy (EDS) map of top surface of a spent industrial coal slag infiltrated pore in an alumina brick. The hercynite grains (green) are attached to the aggregate particles (red) or suspended in the body of slag (blue).

Upcoming Events

- **Commercialization 101 Webinar**, June 20, 2012
This free, 90-minute webinar will provide a basic understanding of commercial business concepts and how to develop a business case for the commercialization of new technology. Contact Jane Engel, jane.engel@contr.netl.doe.gov, for login instructions.
- **Materials Science & Technology 2012**
Conference & Exhibition, October 7–11, 2012
David L. Lawrence Convention Center | Pittsburgh, PA
- **2012 Pittsburgh Coal Conference**, October 15–18, 2012,
David L. Lawrence Convention Center | Pittsburgh, PA
(See article, Page 4)
- **2012 AIChE Annual Meeting, Cleaner Energy, Stronger Economy, Better Living**, October 28–November 2, 2012,
David L. Lawrence Convention Center | Pittsburgh, PA
- **NETL-RUA Fall Meeting: Energy & Innovation Conference**, November 28–29, 2012,
Southpointe Hilton Garden Inn | Canonsburg, PA

Look for more information on these events
in upcoming issues of the newsletter



Technology Spotlight

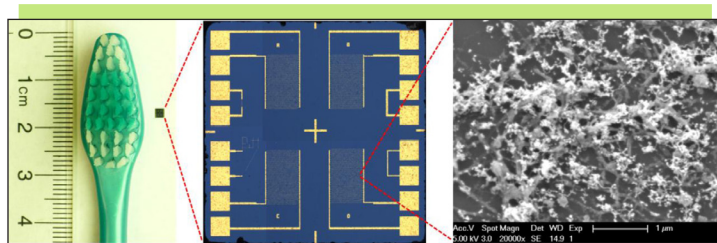
Novel Composite Materials for Applications from Gas Sensing to Personal Healthcare

NETL-RUA researchers from the Department of Chemistry at the University of Pittsburgh (Pitt) and NETL have successfully developed a method to self-assemble gold into nanowires for gas sensing applications. Alexander Star, Gregg Kotchey, and Mengning Ding from Pitt, and Dan Sorescu from NETL have adopted a bottom-up approach in which gold nanowires are built up from gold nanoparticles in suspensions of single-walled carbon nanotubes (SWNTs) treated with various coatings.

In aqueous solution, gold nanoparticles self-assembled on the surface of carbon nanotubes and subsequently underwent a nanowelding process induced by heating. The experimental findings were complemented by density functional theory (DFT) calculations that provided additional insight into the self-assembly and nanowelding mechanisms. The fabricated one-dimensional hybrid nanomaterials comprising gold nanowires and SWNTs demonstrated chemical sensitivity to hydrogen sulfide (H_2S) gas at concentrations as low as 5 parts per billion (ppb) with a wide dynamic range making them suitable materials for sensing the presence of sulfur.

The sensors were selective to H_2S in complex mixtures of gases simulating natural gas and human breath, exhibiting their utility for a wide range of applications from the natural gas industry to industrial safety and personal healthcare.

The results of the study were recently published in the *Journal of the American Chemical Society*.



A closer look at the gold nanowire/SWNT sensor (Left to Right): A size comparison of the sensor chip to a toothbrush. An optical microscope image shows four interdigitated gold electrodes micropatterned on the surface of the chip. Scanning electron microscopy (SEM) reveals the gold nanowire-SWNTs hybrids network bridging two fingers of the interdigitated electrodes.

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Conference Features Demonstration Sessions for Coal-Based Power Systems

The U.S. Department of Energy's National Energy Technology Laboratory (NETL) is hosting a series of technical and business information sessions to be led by internationally recognized experts in applied energy technology deployment, energy policy, investment and financing, and risk management and insurance. These sessions will provide a unique opportunity for interaction among experts in concerned fields. The series, entitled *Clean Coal Demonstration and Commercial Projects*, will be presented at the 29th Annual International Pittsburgh Coal Conference (PCC), October 15–18, 2012.

Plenary speakers, who will address opportunities and challenges in today's coal and power markets, include Charles McConnell, Assistant Secretary for Fossil Energy, U.S. Department of Energy; Sherwood Boehlert, former congressman; and Ke Liu, Vice President and Chief Technology Officer of China's National Institute of Clean & Low-Carbon Energy, as well as current and former officers of regional and multinational energy/power companies.

Sessions will address large-scale clean coal technology (CCT) projects. In six technical sessions, speakers will review developments within current U.S. and international demonstration and commercial projects in CCT production of power, fuels, and chemicals, including carbon capture, utilization, and storage (CCUS), advanced gasification and combustion systems, and syngas clean-up and utilization, as well as regulatory impacts on projects. In three business sessions, presenters will address the financing of, and investment and risk management strategies for, CCT projects.

New this year is the addition of two half-day workshops focused on capital investment analysis and decision making and risk management as applied to implementation of clean coal technology. Workshops will be led by experts in investment analysis and risk management from the Global Association of Risk Professionals and Excidian, LLC. Workshops will be held on October 15, 2012 prior to the start of the PCC.

The PCC will be held at the David L. Lawrence Convention Center in Pittsburgh, PA and is co-hosted by the University of Pittsburgh's Swanson School of Engineering and NETL.

For more information about the Clean Coal Demonstration and Commercial Projects and the workshops, contact session co-chairs Gary Stiegel (gary.stiegel@netl.doe.gov) or Tom Sarkus (thomas.sarkus@netl.doe.gov) or visit the NETL Events Calendar at www.netl.doe.gov.

For registration and additional information about PCC, visit the conference website at www.engr.pitt.edu/pcc.