NETL-RUA
Regional University Alliance

E NEWS

Shared Intellect • Shared Laboratories • Shared Resources

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An Auspicious and Enduring Partnership

Although you may recognize Dr. Roe-Hoan Yoon as an esteemed member of the faculty at Virginia Tech and a valued associate of the NETL-RUA, you may not know that he has maintained a distinguished and productive relationship with the U.S. Department of Energy (DOE) for more than 30 years.

In 1980, just a few short years after he joined the faculty at Virginia Tech, Dr. Yoon partnered with the DOE in a joint program to develop a process that uses microbubbles in a water-filled flotation column to separate mineral impurities from coal. This process, known commercially as Microcel technology, was first patented and commercialized in 1991. It provides coal users — usually utility companies — with lower-ash and lower-sulfur coals that produce less carbon dioxide (CO_2), which means the plants burn more efficiently and thus require less coal to generate a given amount of electricity. Although this technology was developed for coal, it is also being used for processing a variety of different minerals.

Dr. Yoon also directs the Virginia Tech Center for Advanced Separation Technologies (CAST), founded in 2001 under the auspices of the DOE. CAST is a consortium of five universities - West Virginia University (WVU), University of Kentucky, Montana Tech, University of Nevada at Reno, and the University of Utah. The center's goal

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NETL-RUA
METRICS SNAPSHOT

PRODUCTS		
	FY2011	FY2012
Publications	194	195
Patents	11	12
Licenses	9	4
Students Graduated	20 PhD	23 PhD
	8 MS	19 MS

Product data is updated quarterly.

RESEARCH PERSONNEL

Total = 555

- Graduate Students - 112
- Undergraduate Students - 14
- University Researchers - 200
- URS Researchers - 80
- NETL Researchers - 149

HAPPY THANKSGIVING!

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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What's in This Issue

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is to develop advanced separation technologies that can be used to produce cleaner solid, liquid, and gaseous fuels from domestic energy resources in an efficient and environmentally acceptable manner.

Collaboration between NETL and CAST has resulted in two novel technologies for separating moisture from coal slurry that benefit both the environment and economics of mining operations around the world. The first technology is a hyperbaric centrifugal filtration process, first marketed by Decanter Machine Inc. (DMI) of Johnson City, Tennessee, in 2009 under the trade name Centrabaric Centrifuge. This process works like the spin cycle on a washing machine with the addition of compressed air. Combining spinning and compressed air has a synergistic effect and cuts the moisture in half compared to conventional centrifugal methods. The second technology is a patent-pending method that can be used to separate ash and water from ultrafine coal. This new technology has been licensed by Virginia Tech Intellectual Properties, Inc., (VTIP) to Minerals Refining Company, LLC, of Richmond, Virginia, for commercialization.

Dr. Yoon's most recent affiliation with the DOE is, of course, as a member of the NETL-RUA. Since its inception in 2010, Yoon has served as both a principle investigator (PI) on research and as a Consortium Area Lead (CAL). In his role as CAL, Dr. Yoon represents Virginia Tech, serving as a liaison to industry partner URS and the NETL Focus Area Leads (FALs). His responsibilities include helping to coordinate the program and providing invaluable information relative to NETL-RUA research projects. In his work as PI, Yoon has remained committed to advancing separation technologies.

This year, Dr. Yoon led a NETL-RUA team that responded to the DOE funding opportunity announcement (FOA), Energy Innovation Hub – Critical Materials. This opportunity is worth approximately $120 million over a five-year period and addresses issues associated with ensuring a stable supply of materials (rare earth elements and others) critical to energy applications. The team submitted their letter of intent in June of this year and was subsequently invited to submit a full proposal. To date, the proposal has made it through the first round of cuts, and the team was selected for a face-to-face meeting in Washington, DC, that will consist of an oral presentation and a question and answer (Q&A) session. Dr. Yoon will present the team's application to the Hub FOA Federal Merit Review Panel (FMRP) and six to eight independent peer reviewers. If successful, this would be an important win for the NETL-RUA as well as a continuation of an already great partnership between Dr. Yoon and the DOE.

Roe-Hoan Yoon is a University Distinguished Professor at Virginia Tech. He earned his B.S. degree from Seoul National University (1967) and his M.S. (1971) and Ph.D. (1977) degrees from McGill University. He worked as a Research Scientist at the Canada Centre for Minerals and Energy Technology (CANMET) from 1976 to 1978 and joined the faculty of Virginia Tech in January, 1979. He currently serves as Director of CAST.

WVU Awarded Top Prize for Groundbreaking Commercialization Project

WVU's Linking Innovation, Industry and Commercialization (LIINC) project was recently selected as the first-place winner in a national competition sponsored by the University Economic Development Association (UEDA). WVU received the 2012 Award of Excellence Competition in the Innovation and Entrepreneurship category, edging out the Pennsylvania State System of Higher Education and the University at Albany of the State University of New York. Managed by Lindsay Emery, LIINC is a groundbreaking program that urges student and faculty researchers to interact and innovate with private companies to turn ideas into job-creating products.

Emery presented in the competition on behalf of LIINC at the UEDA Annual Summit held in Chattanooga, Tennessee, the week of October 21, 2012. In her presentation, Emery explained how LIINC provides a platform for creation of relationships to encourage a mission-oriented entrepreneurial culture for WVU students and faculty, as well as the private sector.

Sponsored and attended by URS, the summit was a good opportunity to work with a broad cross-section of universities to understand various approaches to higher education-inspired community economic development. These approaches yielded insights on ways that URS can work with NETL-RUA partners to expand NETL's role in regional economic development by leveraging and coordinating research, community resources, talent development, and technology commercialization. WVU President Dr. Jim Clements participated on the University President's Panel that discussed trends, issues, and tactics that are driving university-led economic development; and gave a keynote address on Innovation and the Land-Grant Tradition.

NETL-RUA Develops Novel Approach to Improving Li-ion Battery Performance

Common in consumer electronics, lithium-ion (Li-ion) batteries are one of the most popular types of rechargeable battery with one of the best energy densities, no memory effect, and only a slow loss of charge when not in use. Li-ion batteries have also grown in popularity for military, electric vehicle, and aerospace applications.

It is becoming increasingly important to develop batteries with higher energy density, good cyclability, and fast recharge capability in order to meet the escalating demands of energy storage device applications like smart grid energy and electric vehicles. Graphite is currently the preferred anode used in Li-ion based battery systems.

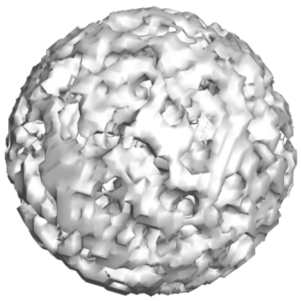
Amorphous silicon (a-Si) films are an attractive alternative to graphite as an anode material because they can provide a 4- to 5-fold increase in storage capacity. Additionally, a-Si exhibits excellent stability over hundreds of charge-discharge cycles—another desirable feature for a rechargeable battery. NETL and the University of Pittsburgh have teamed up on research funded by DOE's Office of Energy Efficiency and Renewable Energy that has resulted in a novel, low-cost approach for depositing a-Si for Li-ion battery anodes, which will improve the performance of the batteries in transportation applications such as hybrid plug-in and electric vehicles. The team has devised a simple electroplating technique to form a-Si films directly on copper foils, which could then be immediately assembled as an anode in a Li-ion battery pack. This technique has the potential to save considerable time and reduce processing costs by eliminating intermediate processes in the traditional battery manufacturing process.

Members of the team include Rigved Epur, Madhumati Ramanathan, Faith Beck, and Prashan Kumta from the University of Pittsburgh, and Ayyakkannu "Mani" Manivannan from NETL. A joint patent application has been filed on the technique, and results of the research have been published in Materials Science and Engineering B entitled "Electrodeposition of amorphous silicon anode for lithium ion batteries," Volume 177, pages 1157-1162, 2012.

Technology Spotlight

Sorbents Working Great, Simulations Are Hoped to Show Why

Sorbent-based technologies for carbon capture have seen tremendous thrust recently. The reasons are due mainly to the large capacities and fast kinetics enabling carbon capture from streams with low CO_2 partial pressures. The objective of NETL-RUA research work by Professor Danesh Tafti and his team at Virginia Tech is to establish a fundamental understanding of the heat and mass transfer in porous particles, phenomena central to solid sorbent CO_2 capture processes. The involvement of intra-particle diffusion of heat and mass through the complex porous microstructure, diffusion through the product layer, and surface reactions add to the technical challenges of the problem at hand. The porous microstructure, constructed using hybrid techniques based on optimized stochastic reconstruction methods, is resolved by using an immersed boundary method (IBM) framework.



Stochastically reconstructed porous spherical particle with porosity of 0.55.

Currently, direct numerical simulations are being performed to quantify the flow of heat and CO_2 with other gases into the porous particles based on measured porosity and microstructure. This, coupled with the reaction kinetics, will enable better control of process variables such as residence times needed within the reactor to achieve a target capture rate and will lead to tailored microstructures for manufactured sorbent particles to best achieve process goals. Better characterization of the porous microstructure influence on solid sorbent based CO_2 capture systems will also help in the development of more accurate reduced-order variable grain models for larger scale simulations with the discrete element method (DEM) and with the Eulerian-Eulerian treatment of fluid-particulate systems. Professor Tafti presented this work at the 2012 NETL Multiphase Conference, which took place on May 22-24, 2012.

NETL-RUA Professor Chosen for Fulbright Program

Dr. Larry Banta, WVU engineering professor and NETL-RUA PI, was recently chosen for the Fulbright Scholar Program sponsored by the Bureau of Educational and Cultural Affairs, U.S. Department of State. The Fulbright Scholar Program is a highly prestigious international award designed to increase mutual understanding between the people of the United States and those of other countries.

Dr. Banta was invited to the University of Genoa (UNIGE) in Italy to work on advanced energy generation and management. He will spend from January through June 2013 working with Dr. Alberto Traverso and others at UNIGE on hybrid generation systems and smart grid concepts. Dr. Traverso worked with Dr. Banta and Dr. David Tucker at NETL during 2010-11. Banta applied to the Fulbright Program to help fund his trip to Genoa, and received notice of the award in March of this year.

During his visit to UNIGE, Dr. Banta will be conducting research on several aspects of fuel cell and gas turbine hybrid electric generation and is looking forward to strengthening existing ties between UNIGE, NETL, and WVU. Dr. Banta has worked in the area of energy efficiency for 30 years.

Upcoming Events

- **Thanksgiving Day**, November 22, 2012
- **NETL-RUA 2012 Fall Conference: 2nd Annual Energy & Innovation Conference**, November 28–29, 2012 | Southpointe Hilton Garden Inn | Canonsburg, PA

Dear Readers,

As we mark the one-year anniversary of the NETL-RUA e-Newsletter with this issue, it is my sincere hope that our newsletter team has been successful in bringing you the most up-to-date news and information about our collaborative efforts. Our goal has been to showcase the important research and innovations that are a result of our unique partnership, as well as to highlight the individual success stories of our members that have benefitted from the NETL-RUA relationship. I thank you for your patronage and for your contributions to the newsletter, and I look forward to sharing our continuing successes with you this upcoming year.

Juli Klara

JULI KLARA, NETL-RUA MANAGER

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