

This portfolio includes research expertise and major facilities at New York's universities and research centers in energy storage including hybrid and electric vehicles, advanced battery technologies, new materials, fuel cells, and other storage systems. Included within each institution are unique facilities and institutes and center directors, key researchers, and active research projects.

Specific tools available at these facilities for research, analysis and prototyping can also be searched on the NYSTAR Research Equipment and Facilities database at: www.nystar.state.ny.us/ref/index.htm

This inventory will be updated periodically as new information is identified (a summary of updates is included on the last page). If you wish to provide additional information, or would like assistance with introductions, please contact NYSTAR at (518) 292-5700.

**Prepared by the New York State
Foundation for Science, Technology and Innovation**

**David A. Paterson
Governor**

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Executive Director**

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MAJOR RESEARCH AREAS IN ENERGY STORAGE AND COMPONENTS:

	Advanced Battery Systems	Advanced Materials & Nano	Fuel Cells	Hydrogen Generation & Storage	Other Energy Storage	Ultra/Super Capacitors
Alfred University	●	●	●	●		●
Binghamton University	●	●	●		●	●
Brookhaven Nat'l Lab	●	●	●	●		●
CUNY	●	●			●	●
Clarkson University	●	●	●	●		●
SUNY ESF	●		●	●		
Columbia University	●	●		●	●	●
Cornell University	●	●	●			
Farmingdale State Univ.			●	●		
CoE in Infotonics	●	●			●	
Polytechnic Institute		●				
RPI	●	●	●			●
RIT	●	●				●
Stony Brook University	●	●	●	●		●
Syracuse CoE					●	●
Syracuse University						
University at Albany	●	●	●			●
University at Buffalo	●	●	●			●
University of Rochester	●	●	●	●		

ALFRED UNIVERSITY

Energy Storage Areas: Advanced Batteries, Capacitors, Fuel Cells, Hydrogen Storage, Intermittent Energy Source Storage Systems

Primary Contact: Dr. Vasantha R.W. Amarakoon, Director of CACT
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Overview

Alfred University is a multidisciplinary research and academic institution, with world renowned expertise in ceramic engineering, materials science, and engineering. Through the use of some of the most sophisticated scientific equipment available, researchers develop new materials, processes, and products to promote environmental sustainability. Basic science investigation is conducted by the Kazuo Inamori School of Engineering.

Centers & Facilities

Center for Environmental and Energy Research specializes in the development of advanced materials and processes through partnerships with industry for clean, renewable, energy, and improvements in materials efficiency, environmental impact, and recycling.

Dr. Terese Vascott, Director
Phone: (607) 871-2983 - Email: vascott@alfred.edu

Center for Advanced Ceramic Technology is a NYSTAR-designated Center for Advanced Technology to work with industry on production and product development challenges related to advanced ceramics. The center focuses on advanced ceramics and processing for electronics, high-temperature structures, photonic applications, bioceramics, whitewares, and advanced manufacturing processes including nanostructured and electromagnetic processing. The Center is working on energy storage devices for Li battery technology and ceramic super multilayer capacitors.

Dr. Vasantha R.W. Amarakoon, Director
Phone: (607) 871-2486 - Email: famarakoo@alfred.edu

Key Researchers & Expertise

Fuel Cells:

Dr. Doreen Edwards, Professor of Ceramic Engineering and Material Science
Phone: (607) 871-2284 - Email: dedwards@alfred.edu

Dr. Alan Meier, Assistant Professor of Materials Science and Engineering
Phone: (607) 871-2462 - Email: meier@alfred.edu

Dr. Scott Mixture, Inamori Professor of Materials Science and Engineering
Phone: (607) 871-2438 - Email: mixture@alfred.edu

Hydrogen Storage:

Dr. Matt Hall, Assistant Professor of Biomaterials
Phone: (607) 871-3143 - Email: hallmm@alfred.edu

Dr. Jim Shelby, John F. McMahon Professor of Glass Science
Phone: (607) 871-2470 - Email: shelbyje@alfred.edu

Storage for Intermittent Energy Sources:

Dr. Jalal Baghdadchi, Associate Professor of Electrical Engineering
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BINGHAMTON UNIVERSITY

Energy Storage Areas: Advanced Batteries, Autonomous Power Systems, Catalysis, Carbon Electrochemistry, Fuel Cells, Heat Transfer, Nanotubes, Microelectronics, Super Capacitors, Thin Film Devices

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Overview

Binghamton University researchers have an international reputation for cutting-edge research in electronics packaging, a national roll-to-roll flexible electronics R&D center, sensor systems and environmental technologies, and a center focused on new materials and synthetic approaches.

Centers & Facilities

Center of Excellence in Small Scale Systems Integration and Packaging (S3IP) encompasses several initiatives focused on electronics packaging, design, and manufacturing techniques. In addition, the Cornell Center for Materials Research is collaborating on research on fundamentals of materials and device technologies. Each of the following centers works collaboratively in this area. Website: <http://expertise.cos.com/cgi-bin/searchexp?code=404>

Center for Autonomous Solar Power is the newest addition to the University's Center of Excellence and focuses on reducing the cost of solar power and enhancing energy efficiency. A focus of the center is developing super capacitors to work with, and independent of, batteries. The multidisciplinary center draws expertise from engineering, computer science, chemistry and physics to focus on solar conversion efficiency, storage capabilities, module stability, and power system cost reduction. Website: <http://www.ieec.binghamton.edu/ieec>

Center for Advanced Microelectronics Manufacturing is a national roll-to-roll manufacturing R&D center spearheading the development of next generation flexible electronics manufacturing. The center's goals are to map emerging flexible electronic technologies, validate design, develop essential process technologies and manufacturing know-how, and demonstrate technologies and products through test-beds and low-volume manufacturing. Website: <http://camm.binghamton.edu>

Integrated Electronics Engineering Center (IEEC) is a NYSTAR-designated Center for Advanced Technology to work with industry on production and product development challenges related to electronics packaging and microelectronic systems development. The center's focus is

supplying electronics packaging research that addresses the process of bringing a semiconductor chip to a form that can be integrated effectively into a larger assembly.

Website: <http://www.ieec.binghamton.edu/ieec>

Contact information for all of the above centers:

Dr. Bahgat Sammakia, Director

Phone: (607) 777-6880 - Email: bahgat@binghamton.edu

Analytical and Diagnostics Laboratory is the University's signature lab for systems integration and packaging and includes sophisticated microscopic and radiation analytical techniques for battery component testing. Website: research.binghamton.edu/binghamtonCOE/Contact.html

Dr. Larry Lehman, Manager

Phone: (607) 777-6841 - Email: llehman@binghamton.edu

Institute for Materials Research brings together a multidisciplinary team from Physics, Chemistry, Geology and the Watson School of Engineering for research on the fundamentals of advanced materials including high energy battery development and capacitors.

Website: <http://imr.chem.binghamton.edu/>

Dr. M. Stanley Whittingham, Director

Phone: (607) 777-4623 - Email: stanwhit@binghamton.edu

Center for Advanced Sensor Systems has a diverse set of skills in sensors and environmental systems and its chemistry, material science, and nanotechnology expertise could assist with energy storage development.

Website: <http://chemistry.binghamton.edu/CASE/>

Dr. Omowunmi Sadik, Director

Phone: (607) 777-4312 - Email: osadik@binghamton.edu

[Key Researchers & Expertise](#)

Advanced Materials and Nanotechnology

Dr. Eric Cotts, Chair, Physics, Applied Physics and Astronomy

Phone: (607) 777-2217 - Email: ecotts@binghamton.edu

Structure, thermal and transport properties of condensed matter, and surfaces and interfaces

Dr. Nikolay Dimitrov, Assistant Professor of Chemistry

Phone: (607) 777-4271 - Email: dimitrov@binghamton.edu

Website: <http://chemistry.binghamton.edu/DIMITROV/dimitrov.htm>

Analytical chemistry

Dr. Howard Wang, Associate Professor of Mechanical Engineering

Phone: (607) 777-3743 - Email: wangh@binghamton.edu

Website: <http://www.me.binghamton.edu/faculty/Wang.html>

Synthesis, processing, and structure/property relations of nanomaterials including polymers, colloids, and carbon nanotubes

Dr. C.J. Zhong, Professor of Chemistry

Phone: (607) 777-4605 - Email: cjZhong@binghamton.edu

Website: www.chemistry.binghamton.edu/ZHONG/zhong.htm

Analytical and materials chemistry, electrochemistry, catalysis, nanotechnology

Autonomous Power Systems and Microelectronics

Dr. Seshu Desu, Dean of the Watson School of Engineering and Applied Science

Phone: (607) 777.2871 - Email: sdesu@binghamton.edu

Website: http://research.binghamton.edu/BinghamtonResearch/2009/Industry_allies2.php

Dr. Alok Rastogi, Visiting Professor of Electrical and Computer Engineering

Phone: (607) 777-4854 - Email: arastogi@binghamton.edu

Microelectronics, thin film devices

Energy Economics

Dr. Zili Yang, Professor of Economics

Phone: (607) 777-4726 - Email: zlyang@binghamton.edu

BROOKHAVEN NATIONAL LABORATORY

Energy Storage Areas: Advanced Batteries, Fuel Cells, Electrolytes and Additives for Li-ion Batteries, Electrocatalysts for Fuel Cells, Hydrogen Storage, Metal Hydrides and Lithium Electrodes, Superconductors, Synthesis

Primary Contacts: Dr. Doon Gibbs, Deputy Director for Science and Technology
Phone: (631) 344-4608 - Email: gibbs@bnl.gov

Dr. Jim Misewich, Associate Lab Director for Basic Energy Sciences
Phone: (631) 344-3501 - Email: misewich@bnl.gov

Overview

Energy storage is a significant thrust within Brookhaven's strategic plan for energy research and development. Developing the next generation of energy storage materials requires understanding the role of structure, morphology, and chemistry – particularly at the nanoscale level and interfaces to determine the performance, safety, and environmental impact of these materials. Through advanced materials characterization, x-ray, and electronic beam analysis, Brookhaven scientists are developing new capabilities to address interfacial phenomena and improve spatial resolution of measurement at the nanometer scale. For example, researchers are using X-rays to examine the chemical process occurring deep within batteries under operation to boost the number of times batteries can be charged and discharged. Primary research areas under development include:

- Electrochemical research to improve efficiency and reliability of fuel cells and batteries
- Nanocatalysis research to develop materials that speed chemical reactions, key to efficient and clean hydrogen production for fuel cells
- Developing high-temperature superconductors to enable efficient energy transmission and storage

Centers & Facilities

The following Brookhaven facilities provide world-leading capabilities for scientific advances at the nanoscale level and are particularly important to developing next generation energy storage.

National Synchrotron Light Source (NSLS) produces very intense x-rays and ultraviolet light by accelerating electrons almost to the speed of light. As magnets put the electrons into circular paths and the electrons turn, photons of light are given off allowing analysis of the molecular structure at the atomic scale. This facility is one of the world's most widely used with 2,100 researchers from 400 universities, government labs, and companies using it each year.

Website: <http://www.nsls.bnl.gov/>

Dr. Chi-Chang Kao, Associate Chairman User Science Division

Phone: (631) 344-4494 - Email: kao@bnl.gov

Future National Synchrotron Light Source (NSLS-II) will be a state-of-the-art, medium-energy electron storage ring with three billion electron-volts designed to produce x-rays more than 10,000 times brighter than the current NSLS at Brookhaven. Design and engineering of the new light source began in 2007 and operations are expected in 2015. Research at NSLS-II will include a focus on nanoscale enabled highly reactive gold nanoparticles to be imaged in situ, inside porous hosts and under real reaction conditions. This could lead to new materials that split water with sunlight for hydrogen production and harvest solar energy with higher efficiency and lower cost. Scientists will also study how materials become high temperature superconductors which could lead to superconducting materials at room temperature for efficient transmission of electricity. Website: <http://www.bnl.gov/nsls2/>

Dr. Steven Dierker, Associate Lab Director for Light Sources

Phone: (631) 344-4966 - Email: dierker@bnl.gov

Center for Functional Nanomaterials provides capabilities for fabrication and study of nanoscale materials with an emphasis on atomic-level tailoring to achieve desired properties and function. Energy storage research includes exploring chemical synthesis methods for photocatalytic materials suitable for producing hydrogen fuel. Brookhaven's expertise in synthesis of nanometer-scale materials provides a complement to strong catalysis programs also underway.

Website: <http://www.bnl.gov/cfn/>

Dr. Emilio Mendez, Director

Phone: (631) 344.4176 - Email: emendez@bnl.gov

New York Center for Computational Sciences is a high performance computing collaboration between Brookhaven National Lab and Stony Brook University. The supercomputer, dubbed New York Blue, has more than 36,000 processors for a total of 103 teraflops (103 trillion calculations/second or 10,000 times faster than a standard PC). The system is capable of modeling complex energy storage components and simulations quickly to accelerate research and allow researchers and companies to focus resources on areas with the greatest potential.

Website: <http://www.newyorkccs.org/>

Dr. Patrick Looney, Asst Lab Director, BNL Co-Director of NYCCS

Phone: (631) 344-2345 - Email: jlooney@bnl.gov

Dr. Yacov Shamash, VP for Economic Development and Dean of the College of Engineering and Applied Sciences, Stony Brook Co-Director of NYCCS

Phone: (631) 632-8380 - Email: Yacov.Shamash@stonybrook.edu

Joint Photon Sciences Institute (JPSI) is a new initiative in photon sciences to capitalize on the capabilities of Brookhaven's proposed National Synchrotron Light Source II through a

Department of Energy/New York State partnership. JPSI will enhance scientific programs that rely on the machine's powerful photon beams by fostering collaborative, interdisciplinary R&D. This will enable the study of materials properties and functions at the nanoscale level with an unprecedented level of detail and precision. An important element of the institute's mission will also be training new researchers. Website: <http://www.bnl.gov/nsls2/jpsi.asp>

Dr. Chi-Chang Kao, Founding Director

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Key Researchers & Expertise

Designing Better Electrocatalysts for Fuel Cells

Research is underway to understand the correlation between structure and function at electrochemical surfaces with a focus on design of efficient low platinum content electrocatalysts that may be used to convert hydrogen to electricity in fuel cells for electric vehicles. Researchers are using in situ and ex situ synchrotron radiation, surface science, infrared, and electrochemical techniques to study the structural, electronic and catalytic properties of electrocatalysts for O₂ reduction, methanol, ethanol, and CO oxidation reactions, combined with kinetic analyses of the O₂ reduction reaction and intensive density functional theory calculations. Technologies developed include:

- Electrocatalyst for Alcohol Oxidation at Fuel Cell Anodes
- Synthesis of Metal-Metal Oxide Catalysts and Electrocatalysts
- Platinum Metal-Oxide Composite Particles
- Gold Monolayers on Platinum Nanoparticle Cores
- Palladium-Cobalt Particles as Oxygen-Reduction Electrocatalysts
- Synthesis of Metal-Coated Palladium and Palladium-Alloy Particles
- Platinum and Platinum Alloy-Coated Palladium and Palladium Alloy Particles
- Carbon Monoxide Tolerant Fuel Cell Electrocatalyst
- Anodes to Oxidize Alcohol in Fuel Cells

Additional information: <http://www.bnl.gov/techxfer/IntellectualProperty/LicEnergy.asp#Electrocatalyst>

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Website: <http://www.bnl.gov/chemistry/bio/AdzicRadoslav.asp>

Hydrogen Storage

Hydrogen storage has been identified as the bottleneck in the development of hydrogen-fueled vehicles. The conventional storage method, compressed H₂ gas, requires large tank volume and the possibility of tank rupture poses a safety risk. Other methods involve condensing and cooling the H₂ gas to 20°K (-423.0°F) where it forms liquid H₂. However, a considerable amount of energy is used to maintain the low temperature required to keep the hydrogen in the liquid state. An alternative to more traditional methods is to store hydrogen in the solid state. This can be accomplished with adsorbents (e.g. carbon) where hydrogen is attached to the surface of a solid, or absorbents (e.g. metal hydrides) where hydrogen is inserted in between the atoms in a solid.

The key requirements for a hydrogen storage material in automotive applications are high gravimetric and volumetric hydrogen densities, release of hydrogen at moderate temperatures and pressures, and low-cost method to recharge the material back to its

original state. The US Department of Energy hydrogen storage system goals for the year 2010 are a 6.0 weight percent gravimetric capacity and a volumetric capacity of 0.045 kg/L. Conventional metal hydrides that can readily supply hydrogen at room temperature have storage capacities < 2 wt. percent and cannot satisfy this need. However, a number of alternative metal hydrides being investigated at Brookhaven including aluminum hydride (AlH_3) and complex metal hydrides such as lithium aluminum hydride (LiAlH_4) have appreciable gravimetric and volumetric hydrogen capacities and may be able to meet these targets. Further information on hydrogen storage research at Brookhaven can be found at: <http://www.bnl.gov/est/erd/hydrogenStorage/>.

Dr. Jason Graetz, Research Associate
Phone: (631) 344-3242 - Email: graetz@bnl.gov
Metal hydrides and lithium electrodes

Nanostructured Materials for Lithium Batteries

Brookhaven is developing nanostructured lithium battery materials for transportation including plug-in hybrid electric vehicles and all-electric vehicles. Researchers at BNL are partnering with Stony Brook University to perform exploratory synthesis of new battery materials and conduct in situ characterization. Electrochemical testing is performed to understand how cycle life changes with morphology and microstructure and how electrochemical kinetic studies determine cycling rates. New methods and diagnostic techniques for time-resolved electrochemical investigations are also being developed.

Dr. Jason Graetz, Research Associate
Phone: (631) 344-3242 - Email: graetz@bnl.gov
Website: <http://www.bnl.gov/est/erd/staff/graetz/>
Synthesis and characterization of nanostructured anodes and cathodes

Dr. Xiao-Qing Yang, Chemist
Phone: (631) 344-3663 - Email: xyang@bnl.gov
Website: <http://www.bnl.gov/chemistry/bio/YangXiao-Qing.asp>
Development of new electrolytes and additives

CITY UNIVERSITY OF NEW YORK (CUNY)

Energy Storage Areas: Electrolyte-Electrode Interface, Electrochemistry, Electrode Materials Development, Flow Batteries, Gas Hydrates, Heat Transfer, Ionic Liquids, Li-Ion Systems, Nanoporous Carbon Materials, Novel Electrolytes, Printable Batteries, Steam Energy Storage, Super Capacitors,

Primary Contact: Dr. Gillian M. Small, Vice Chancellor for Research
Phone: (212) 794-5417 - Email: Gillian.Small@mail.cuny.edu

Overview

The City University of New York is the nation's largest urban public university. CUNY comprises 23 institutions including eleven senior colleges, six community colleges, and specialized institutions. CUNY hosts more than 100 nationally recognized research centers, institutes and consortia. The NYSTAR-designated New York Structural Biology Center at City College is a new

state-of-the-art magnetic resonance technology facility run by a CUNY-led consortium of nine major medical institutions. University centers of advanced research include the NYSTAR Center for Advanced Technology in Photonics Applications, the Institute for Ultrafast Spectroscopy and Lasers, and the Institute of Macromolecular Assemblies. In 2005, the University began its Decade of Science initiative to address the urgent need for a healthy pipeline to the STEM fields (Science, Technology, Engineering, and Mathematics) through advanced research, teacher education, and increased student participation.

Centers & Facilities

Center for Engineered Polymeric Materials is a NYSTAR-designated center to work with industry on production and product development challenges related to complex polymeric materials based on multiple phases with significant structure at the nanometer scale.

Website: <http://www.chem.csi.cuny.edu/cepm/index.htm>

Dr. Nan-Loh Yang, Director, Center for Engineered Polymeric Materials

Phone: (718) 982-3899 - Email: yang-n@mail.csi.cuny.edu

Center for Sustainable Energy was established in 2003 at Bronx Community College and is funded by the U.S. Department of Energy. The center's mission is to promote use of renewable and efficient energy technologies in urban communities through education, training, and workforce development. Website: <http://www.bcc.cuny.edu/institutionalDevelopment/cse/>

Dr. Tria Case, Executive Director

Phone: (718) 289-5332 - Email: tria.case@bcc.cuny.edu

Key Researchers & Expertise

Advanced Materials, Surface Engineering and Analysis

Dr. Sanjoy Banerjee, Professor, City College

Phone: (212) 650-5728 - Email: banerjee@che.ccny.cuny.edu

Website: <http://www1.ccny.cuny.edu/prospective/engineering/departments/chemical/faculty/Sanjoy-Banerjee.cfm>

Multiphase, complex-fluid, turbulent/chaotic and environmental systems. Studies range from nanoscale (e.g. spinodal decomposition in shear flows, coalescence, and flow interactions with macromolecular structures like cell-membrane receptors and channels) to macroscale such as turbulent transport processes

Dr. Alexander Couzis, Professor, City College

Phone: (212) 650-6701 - Email: acouzis@ccny.cuny.edu

Website: <http://www1.ccny.cuny.edu/prospective/engineering/departments/chemical/faculty/AlexanderCouzis.cfm>

Surface engineering, templated crystallization, biosensors, surfactants

Dr. Steve Greenbaum, Professor, Hunter College

Phone: (212) 772-4973 - Email: sgreenba@hunter.cuny.edu

Website: <http://www.ph.hunter.cuny.edu/faculty/greenbaum/Research.html>

Evaluation of materials for fuel cells and lithium batteries

Dr. Ilona Kretzschmar, Professor, City College

Phone: (212) 650-6769 - Email: kretzschmar@ccny.cuny.edu

Website: <http://www-che.engr.ccny.cuny.edu/ilona/public/>

Nano and microparticles modification and assembly

Dr. Alan Lyons, Co-Director Center for Engineered Polymeric Materials, Staten Island

Phone: (718) 982-3951 - Email: lyons@mail.csi.cuny.edu

Website: http://scholar.library.csi.cuny.edu/~lyons/AML_home_files/frame.htm

Thermal management materials

Dr. Michael Mirkin, Professor, Queens College

Phone: (718) 997-4111 - Email: mmirkin@qc.cuny.edu

Website: <http://chem.qc.edu/~mirkinlab/research.htm>

Nanoelectrochemistry including charge-transfer reactions at the solid/liquid and liquid/liquid interfaces, and mechanisms of stress corrosion

Ionic Liquids

Dr. Robert Engel, Professor, Queens College

Phone: (718) 997-4106 - Email: robert_engel@qc.edu

Website: <http://chem.qc.cuny.edu/~rengel/Research/ri.htm>

Conversion of polycationic organic salts into ionic liquids and their attachment to surfaces

Dr. Mark Kobrak, Professor, Brooklyn College

Phone: (718) 951-5758 - Email: mkobrak@brooklyn.cuny.edu

Website: <http://userhome.brooklyn.cuny.edu/mkobrak/>

Dr. Sharon Lall-Ramnarine, Queensborough Community College

Phone: (718) 281-5485 - Email: slallramnarine@qcc.cuny.edu

Website: <http://www.qcc.cuny.edu/chemistry/Faculty/Lall-Ramnarine.asp>

Design and characterization of new types of organic compounds including ionic liquids

Steam, Gas and Thermal Energy Storage

Dr. Teresa Bandosz, Professor, City College

Phone: (212) 650-6017 - Email: bandosz@sci.ccny.cuny.edu

Website: http://www.sci.ccny.cuny.edu/~tbandosz/research_summary.htm

New sorbents and catalysts; Surface characterization; Methane/natural gas/hydrogen storage and gas separation

Dr. Masahiro Kawaji, Professor, City College

Phone: (212) 650-8584 - Email: kawaji@me.ccny.cuny.edu

Website: <http://www1.ccny.cuny.edu/prospective/engineering/departments/chemical/faculty/Masahiro-Kawaji.cfm>

Multiphase flow and phase change heat transfer, nuclear reactor thermal-hydraulics and safety analysis, microfluidics, micro-heat pipes, microgravity fluid physics and transport phenomena, and thermal energy storage

Dr. Jae Lee, Professor, City College

Phone: (212) 650-6688 - Email: jalee@ccny.cuny.edu

Website: <http://www1.ccny.cuny.edu/prospective/engineering/departments/chemical/faculty/JaeLee.cfm>

Gas hydrate formation for use as a gas storage medium

Dr. Reuel Shinnar, Professor, City College

Phone: (212) 650-6679 - Email: shinnar@che-mail.engr.ccny.cuny.edu

Website: <http://www-che.engr.ccny.cuny.edu/faculty/shinnar/>

A team of researchers led by Dr. Shinnar has developed a new low-cost, large-scale steam energy storage system with potential to increase base load capacity up to 30% for conventional power plants, while providing dispatchable energy as needed to regulate large-scale green

power to the grid. In addition, this system could potentially enable solar thermal power plants to supply electricity 24/7, while reducing cost of electricity generation at each installation.

Super Capacitors and Sensors

Dr. Michal Kruk, Professor, College of Staten Island
Phone: (718) 982-4030 - Email: kruk@mail.csi.cuny.edu

Dr. Dan Steingart, Professor, City College
Phone: (212) 650-7146 - Email: steingart@che.ccny.cuny.edu
Website: <http://www1.ccny.cuny.edu/prospective/engineering/departments/chemical/faculty/DanSteingart.cfm>
Electrochemistry, printable devices, wireless sensor networks, and energy storage

CLARKSON UNIVERSITY

Energy Storage Areas: Energy Harvesting and Storage, MEMS Sensor Platform for Hydrogen Storage and Safety, Modeling and Optimization of Fuels Cell Technologies, Super Capacitors, Solid Oxide Fuel Cells and Proton Exchange Membrane Fuel Cells, Polymer Nanocomposites

Primary Contact: Dr. S.V. Babu, Director of the Center for Advanced Materials Processing
Phone: (315) 268-2336 - Email: babu@clarkson.edu

Overview

Clarkson University through the Center for Sustainable Energy has been engaged in energy research and education for over 30 years. In addition, the Center for Advanced Materials Processing is the lead Clarkson institute for advanced materials development for industry applications, particularly in colloid and surface science and fine particle technology.

Centers & Facilities

The Center for Advanced Materials Processing is a NYSTAR-designated Center for Advanced Technology to work with industry on production and product development challenges related to advanced materials development. Focus is on high-technology materials processing and is built on Clarkson's expertise in colloid and surface science and fine particle technology. Research includes production, modification and conversion of matter for which small particles, colloidal media and surfaces play an important role in the properties of the final product. A MEMS sensor platform for fuel cells is also being developed in collaboration with Cornell University to sense hydrogen concentrations and pressures for safety in storage.

Website: <http://www.clarkson.edu/camp/index.html>

Dr. S.V. Babu, Director
Phone: (315) 268-2336 - Email: babu@clarkson.edu

Center for Sustainable Energy Systems - Faculty in this research group are collaborating with Cornell University in the development of energy harvesting and storage technologies including an array of self-tuning mechanical oscillators to be fabricated using MEMS technology.

Dr. Cetin Cetinkaya, Department of Mechanical and Aeronautical Engineering
Phone: (315) 268-6514 - Email: cetin@clarkson.edu

Key Researchers & Expertise

Fuel Cells & Hydrogen Storage

Dr. Dan Goia, CAMP Distinguished Professor

Phone: (315) 268-3411 - Email: goiadanv@clarkson.edu

Proton exchange membrane and solid oxide fuel cells, electromagnetic interference shielding, and metallurgical applications

Dr. Ian Suni, Department of Chemical and Biomolecular Engineering

Phone: (315) 268-4471 - Email: isuni@clarkson.edu

MEMS sensor development to sense hydrogen concentrations and pressures for safety and storage. Other projects include modeling and optimization of industrial solid oxide fuels cells, use of super capacitors for improving the transient response of fuel cells and incorporation of new nano materials for solid oxide fuel cells and proton exchange membrane fuel cells.

Power Systems

Dr. Thomas Ortmeyer, Department of Electrical and Computer Engineering

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Works within Clarkson's High Voltage Laboratory to conduct life testing capability to integrate intermittent renewable energy sources into the existing power grid

COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY, SUNY

Energy Storage Areas: Hydrogen, Membrane Development

Primary Contact: Dr. Neil Ringler, Dean of Research

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Dr. Israel Cabasso is conducting research into membrane development associated with hydrogen storage and other applications. Formation and preparation of synthetic membranes also includes the fundamentals of the mass-transport phenomenon in polymers, interaction of small molecules that diffuse through membrane matrices, and technological aspects associated with use of polymer membranes in electrochemical applications (fuel cells, double layer capacitors), reverse osmosis, separation of gas mixtures, and rechargeable batteries. Dr. Cabasso is working under sponsorship of the US DOE on hydrogen storage (\$1.6 million grant over five years) and also on PEM fuel cells. Previously, work was done with Niagara Mohawk on hydrogen storage, PEM fuel cells, and batteries for energy storage (electrochemistry).

Phone: (315) 470-6857 - Email: icabasso@syr.edu

Website: <http://www.esf.edu/polymer/cabasso.htm>

COLUMBIA UNIVERSITY

Energy Storage Areas: Advanced Batteries, Battery Cathodes, Charge-Recycling, Chemical Energy Storage, Energy Monitoring, Flywheel Storage, Hydrogen Storage, Li-ion Batteries, Low Voltage Sampling, Nuclear Reactor Fuels, Regenerative Fuel Cells, Super Capacitors, Thin Film, Thermoelectrics

Primary Contact: Victoria Hamilton, Research Initiatives Coordinator

Phone: (212) 854-1343 - Email: victoria.hamilton@columbia.edu

Overview

Primary emphasis on energy storage includes nanotechnology applications in advanced batteries, non-battery energy storage techniques, and regenerative fuel cells. Several centers also work in energy policy including the Center for Energy, Marine Transportation and Public Policy (www.cemtp.org).

Centers & Facilities

Nanoscale Science and Engineering Center is a NYSTAR supported center expanding its expertise in nanoscale electronic devices to better understand the nanoscale physics of charge generation and separation. This work includes support from GE, IBM, and Heliovolt. In addition, the Center for Nanostructured Materials (a National Science Foundation Materials Research Science and Engineering Center) is developing and examining new types of nanocrystals and assembly techniques including synthesis of complex metal oxide nanocrystals and assembly. Website: www.cise.columbia.edu/nsec/

Dr. James T. Yardley, Senior Research Scientist and Director
Phone: (212) 854-3839 - Email: jy307@columbia.edu

Center for Life Cycle Analysis guides technology and energy policy decisions with data-based, well balanced and transparent descriptions of the environmental profiles of energy systems. The center is conducting comprehensive life cycle analyses of energy systems to provide a framework for quantifying the potential environmental impacts of material and energy inputs and outputs of a process or product. Website: www.clca.columbia.edu

Dr. Vasilis Fthenakis, Director
Phone: (212) 854-8885 - Email: vmf5@columbia.edu

Key Researchers & Expertise

Advanced Batteries

Dr. Chris A. Marianetti, Professor, Applied Physics
Phone: (212) 854-9478 - Email: chris.marianetti@columbia.edu
Website: www.seas.columbia.edu/matsci/fac-bios/marianetti/faculty.html

Materials with potential applications for energy storage or conversion such as battery cathodes, nuclear reactor fuels, thermoelectrics, and hydrogen storage materials.

Dr. Alan West, Chair, Department of Chemical Engineering
Phone: (212) 854-4452 - Email: acw7@columbia.edu
Website: www.cheme.columbia.edu/fac-bios/west/faculty.html

Fundamentals underlying electrochemical technologies including microfabrication processes, sensors, fuel cells, and batteries. Research includes DOE supported work on Advanced Batteries.

Charge-Recycling Technology

Dr. Kenneth Shepard, Professor Electrical Engineering
Phone: (212) 854-2529 - Email: shepard@ee.columbia.edu
Website: www.ee.columbia.edu/fac-bios/shepard/faculty.html

Conducting research into charge-recycling technology that could be used to develop ultra-low-power consumption monitoring by allowing for integrated circuits to achieve higher efficiency by recycling electrical charge within the chip. This power that would otherwise be wasted as heat is used to supply energy for other parts of the same chip.

Chemical Energy Storage

Dr. Marco Castaldi, Professor, Earth & Environmental Engineering

Phone: (212) 854 6390 - Email: mc2352@columbia.edu

Reaction engineering for use of biomass and carbon dioxide to produce high value products; catalytic reaction engineering to upgrade low energy fuels for low carbon energy production; flame chemistry for novel applications of CO₂ usage; non-equilibrium catalytic reactions applied to highly selective processes such as oxidative coupling; coal-biomass reactions; use of CO₂ as a diluent in combustion systems.

Dr. Kartik Chandran, Professor, Earth and Environmental Engineering

Phone: (212) 854-9027 - Email: kc2288@columbia.edu

Converting biomass directly to electricity; algae to biodiesel and biomass to methane using biological processes to capture the energy in waste streams

Compressed Air Storage and Advanced Batteries

Dr. Vijay Modi, Professor, Mechanical Engineering

Phone: (212) 854-2956 - Email: modi@columbia.edu

Website: www.me.columbia.edu/fac-bios/modi/lab.html

Energy sources and conversion, heat/mass transfer, and fluid mechanics including energy infrastructure, CO₂ sequestration, fuel cells, distributed sensing/control of flow, and heat transfer; also has patented a rugged low cost storage battery with custom-designed circuitry under evaluation at several companies that maximizes life by controlling charging/discharging.

Energy Monitoring

Dr. Peter Kinget, Associate Professor Electrical Engineering

Phone: (212) 854-0309 - Email: pk171@columbia.edu

Website: www.ee.columbia.edu/~kinget/

For the next generation smart grid infrastructure and smart battery systems, it will become necessary to implement monitoring of energy flows at a more precise level than monitored today. Knowledge at a higher granularity will allow more efficient and secure energy storage. Dr. Kinget's lab is working on low voltage sampling technology that could potentially be used for energy storage monitoring.

Flywheel Energy Storage

Dr. Roger Anderson, Doherty Senior Scholar, Marine Geology and Geophysics

Center for Computational Learning Systems and Lamont-Doherty Earth Observatory

Phone: (845) 365-8335 - Email: anderson@ldeo.columbia.edu or

Anderson@ccls.columbia.edu

Website: <http://leanenergy.ldeo.columbia.edu/>

Working with the Metropolitan Transit Authority on flywheel energy storage and with Columbia's Center for Computational Learning Systems and Consolidated Edison to develop techniques for a smart energy grid

Super Capacitors

Dr. Ioannis (John) Kymissis, Assistant Professor, Electrical Engineering

Phone: (212) 854-4023 - Email: johnkym@ee.columbia.edu

Website: <http://kymissis.columbia.edu>

Dr. Kymissis' lab has coupled thin film deposition and packaging equipment that allows handling and encapsulation of highly air unstable materials including metallic lithium and

calcium for batteries and processing and handling of ultra-high capacitance dielectric materials such as nanoparticle barium titanate. The team has also started work in thin film lithium batteries to complement current projects in thin film solar cells and piezoelectric energy harvesting.

Dr. Stephen P. O'Brien, Adjunct Associate Professor, Applied Physics/Applied Math

Phone: (212) 854-9477 - Email: so188@columbia.edu

Website: www.apam.columbia.edu/misc-pages/obrien.html

High purity nanoparticles with accurate control over diameter; this technology is described in two patent applications and in collaborations with General Electric and SBA Materials.

CORNELL UNIVERSITY

Energy Storage Areas: Advanced Fuel Cells, Catalytic Transformations, Properties of Magnetic and Superconducting Ceramics, Reactive Surface Chemistry and Thin Film Deposition

Primary Contact: Dr. Robert A. Buhrman, Senior Vice Provost for Research

Phone: (607) 255-7200 - Email: rab8@cornell.edu

Overview

Cornell is the federal land-grant institution of New York State, a private endowed university, and a partner of the State University of New York. Cornell is a world-class research university and boasts more than 100 interdisciplinary research organizations.

Centers & Facilities

Cornell Center for Materials Research (CCMR) is a NYSTAR supported center to advance materials purposefully structured at the nanoscale (near-atomic dimensions) for new properties and applications. The aim of the center is to help companies through the design and control of crystalline and disordered nanomaterials. Website: <http://www.ccmr.cornell.edu/>

Dr. Melissa Hines, Director

Phone: (607) 255-4273 - Email: Melissa.Hines@ccmr.cornell.edu

Cornell NanoScale Science & Technology Facility is a NYSTAR funded center that supports a broad range of nanoscale science and technology projects by providing state-of-the-art resources coupled with expert staff support. Over 700 users per year, 50 percent of whom come from outside Cornell, use the Center's fabrication, synthesis, computation, characterization, and integration resources to build structures, devices, and systems from atomic to complex length-scales.

Website: <http://www.cnf.cornell.edu/> or http://www.cnf.cornell.edu/cnf_processes.html

Dr. Donald Tennant, Director of Operations

Phone: (607) 254-6203 - Email: tenant@cnf.cornell.edu

Cornell Fuel Cell Institute, part of the NYSTAR-designated Center for Advanced Technology in Future Energy Systems at RPI, is focused on developing advanced materials for lower-temperature, polymer electrolyte membrane (PEM) fuel cells. Many automobile manufacturers, together with the US Department of Energy, are focusing on PEM fuel cells for the cars of the

future. The mission of the center is to develop the novel materials for advanced fuel cell components and overcome the fundamental limitations in performance, durability and cost of current technologies. The center has collaborations with industrial and academic leaders in the fuel cell sector to speed incorporation of material discoveries into commercial fuel cell devices and into lithium ion batteries and redox capacitor applications. Website: <http://cfci.ccmr.cornell.edu/>

Dr. Héctor Abruña, Co Director, Cornell Fuel Cell Institute

Phone: (607) 255-4720 - Email: hda1@cornell.edu

Website: <http://abruna.chem.cornell.edu/people1.html>

Dr. Frank DiSalvo, Co Director, Cornell Fuel Cell Institute

Phone: (607) 255-7238 - Email: fjd3@cornell.edu

Website: <http://www.chem.cornell.edu/faculty/index.asp?fac=25>

Key Researchers & Expertise

Advanced Materials

Dr. James R. Engstrom, Professor

Phone: (607) 255-9934 - Email: jre7@cornell.edu

Website: <http://vivo.cornell.edu/individual/vivo/individual6090>

Studies of reactive surface chemistry and thin film deposition

Dr. Emmanuel P. Giannelis, Professor

Phone: (607) 255-9680 - Email: epg2@cornell.edu

Website: <http://vivo.cornell.edu/individual/vivo/individual6088>

Dr. Ronald Hoffmann, Professor Emeritus

Phone: (607) 255-3419 - Email: rh34@cornell.edu

Website: <http://vivo.cornell.edu/individual/vivo/individual6072>, <http://www.roaldhoffmann.com/pn/>

Electronic and molecular structure

Dr. Robert B. Van Dover, Professor

Phone: (607) 255-3228 - Email: rbv2@cornell.edu

Website: <http://vivo.cornell.edu/individual/vivo/individual7030>

Growth and properties of magnetic, dielectric, superconducting, and optical thin films; fabrication and characterization of thin film devices; properties of magnetic and superconducting ceramics

Dr. Ulrich B. Wiesner, Spencer T. Olin Professor

Phone: (607) 255-3487 - Email: ubw1@cornell.edu

Website: <http://vivo.cornell.edu/individual/vivo/individual6112>

Interdisciplinary approach to soft materials with emphasis on the study of block copolymers, ranging from synthetic aspects of polymer science to physics of complex fluids under shear flow

Polymer Chemistry

Dr. Geoff Coates, Professor

Phone: (607) 255-5447 - Email: gc39@cornell.edu

Website: <http://www.chem.cornell.edu/gc39/>

Design, synthesis, characterization, and applications of polymers with an emphasis on catalytic transformations and the control of stereochemistry

FARMINGDALE STATE UNIVERSITY, SUNY

Energy Storage Areas: Regenerative Fuel Cells, Hydrogen Generation, Water Electrolyzers

Primary Contact: Dr. Hazem Tawfik, Distinguished Professor and Director, Institute for Research and Technology Transfer

Phone: (631) 420-2307 - E-mail: tawfikhh@farmingdale.edu

Over the past eight years, the Institute for Research and Technology Transfer has worked with industry to develop an innovative metallic bipolar technology. The new bipolar plates are noted for their durable, efficient and cost effectiveness in comparison to the graphite composite plates currently known as the industry standard. In the hydrogen PEM fuel cell industry, these plates function as the backbone of the power stack, provide conduits for the reactant gases, and conduct current between cells. In the water electrolyzers, these metallic plates act as separators between water and gases and are considered the main component for the regenerative fuel cells and hydrogen generation. Dr. Tawfik reports this technology could provide hydrogen consumption savings of up to 24 percent compared to graphite composite plates used today.

INFOTONICS TECHNOLOGY CENTER

Energy Storage Areas: MEMS and Sensors, Micro-Energy Harvesting

Primary Contact: Glenn Fricano, VP Sales and Marketing

Phone: (585) 919-3000 - Email: glenn.fricano@infotonics.org

The Infotonics Technology Center, a New York State-designated Center of Excellence, conducts research and product development into microelectromechanical systems development, fabrication and packaging. Facilities include 23,000 square feet of clean room space and a full range of MEMS-related services. The facility enables new microchip embedded devices and sensors to be developed from bench top to pilot scale manufacturing within a single location. The center has explored use of micro-energy harvesting which is designed to provide micro-watts of power with potential in many electronic applications. The goal of micro-energy harvesting is the elimination of batteries in small devices by converting available ambient energy (vibration, heat, wind, etc.) into usable electrical energy. This would be particularly the case for wireless networks that could be used to monitor appliances within residential and commercial buildings and for new networks that could monitor physical structures such as bridges where it is impractical to deploy thousands of battery-powered sensors. Website: <http://www.itcmems.com/> or http://www.itcmems.com/Publications/Documents/WhitePaper_Energy_Harvesting_for_RF_Sensors.pdf

POLYTECHNIC INSTITUTE OF NEW YORK UNIVERSITY

Energy Storage Areas: Bioplastics, Advanced Materials

Primary Contact: Kurt H. Becker, PhD, Assoc. Provost for Research and Technology Initiatives; Phone: (718) 260-3608 - Email: kbecker@poly.edu

Overview

Founded in 1854, NYU-Poly is the second oldest private engineering school in the United States. Among our graduates and faculty are Nobel laureates, notable inventors, world class scientists

and successful entrepreneurs. Many NYU-Poly faculty are among the top researches in their fields. NYU-Poly is home to one of New York's first Centers for Advanced Technology, the Center for Advanced Technology in Telecommunication and Information Systems (CATT).

Centers & Facilities

Two of the various Research Centers and Institutes at NYU-Poly are of particular importance to the area of Energy Storage and Components.

The **Center for Biocatalysis and Bioprocessing of Macromolecules** carries out research at the interface of Engineering, Macromolecules and the Biological sciences. The Center is involved in the exploration and development of enzymes for a wide range of polymer forming and modifying reactions. The Center also provides Industrial Members with critical cutting edge research on enzyme transformations related to polymer technology.

Prof. Richard Gross, Director

Phone: (718) 260-3984 - E-mail: rgross@poly.edu

The **Polymer Research Institute** is an internationally recognized leader in the synthesis, characterization, structure, processing, properties, and applications of polymeric materials. The Institute provides a focal point for over 25 faculty members in Chemistry, Chemical Engineering, and Physics around which to direct their research efforts. In addition to the traditional chemistry related areas, PRI has recently expanded its interests in macromolecular technology to health related areas.

Prof. Yoshi Okamoto, Director

Phone: (718) 260-3638 - E-mail: yokamoto@poly.edu

Key Researchers & Expertise

Advanced Materials

Dr. Richard A. Gross, Herman F. Mark Professor, Department of Chemical and Biological Sciences & Director of the NSF Center for Biocatalysis and Bioprocessing of Macromolecules
Phone: (718) 260-3984 - E-mail: rgross@poly.edu

Dr. Nikhil Gupta, Assistant Professor of Mechanical Engineering
Phone: (718) 260-3080 - E-mail: ngupta@poly.edu

RENSSELAER POLYTECHNIC INSTITUTE (RPI)

Energy Storage Areas: Nanostructured Silicon Anodes for Li-ion Batteries, Battery System Level Design and Optimization, Li-ion Battery Processes and Systems, Ionic Transport Modeling in Battery Materials, New Paper Batteries

Primary Contact: Dr. Wolf W. von Maltzahn, Acting VP for Research
Phone: (518) 276-4873 - Email: vonmaw@rpi.edu

Overview

Rensselaer Polytechnic Institute was established in 1824 as the first technological university in the U.S. The scientific and technical themes include biotechnology, energy security, information technology, and nanotechnology. RPI has developed relationships with hundreds of their

academic colleagues, national funding institutions, diverse federal laboratories, and more than 200 industrial affiliates on specialized projects.

Centers & Facilities

Center for Future Energy Systems is a NYSTAR-designated Center for Advanced Technology to work with industry on production and product development challenges related to new energy technologies and energy efficiency. In addition to renewable energy development and efficiency projects, the center is supporting research in intelligent building architectures, fuel cells (in partnership with Cornell University), battery and energy technologies, and distributed generation grid testing. Website: <http://www.rpi.edu/cfes/>

Dr. G. Ramanath, Director

Phone: (518) 276-6844 - Email: ramanath@rpi.edu

Supporting facilities at RPI include:

- Energy Nanomaterials and Device Laboratory
- Electronic Materials Laboratory
- Nanoscale Thermophysics and Energy Conversion Laboratory
- Thermal Chemical Vapor Deposition and Oblique Angle Laboratory
- Thin Films and Nanostructure Laboratory
- 3D Integration Laboratory
- Chemical Engineering Computing Laboratory
- Electron Microscopy Laboratory
- Micro-Nano Fabrication Clean Room
- Fuel Cell and Hydrogen Laboratory
- Surface Analysis and Ultrafast Laser Laboratory

Computational Center for Nanotechnology Innovations operates massively-paralleled IBM Blue Gene supercomputers, Power-based Linux clusters and AMD Opteron processor-based clusters to provide up to 70 teraflops of computational power and associated networking and storage. This system is used for new generations of modeling and simulation methods aimed at dramatically reducing the time and cost of design for devices and products that depend on the control of nanoscale processes. Website: <http://www.rpi.edu/research/ccni/index.html>

Dr. John E. Kolb, VP for Information Services and Technology and CIO

Phone: (518) 276-2122 - Email: kolbj@rpi.edu

Researchers & Expertise

Advanced Batteries and Materials

Dr. Stephen J. Derby, Director, Flexible Manufacturing Center

Phone: (518) 276-6991 - Email: derbys@rpi.edu - Website: http://www.cats.rpi.edu/fac_derby.html
Modular automation, robotics, and manufacturing. Dr. Dory is also pursuing research into Li-ion battery manufacturing processes and systems.

Dr. Jonathan S. Dordick, Howard P. Isermann Professor

Phone: (518) 276-2899 - Email: dordick@rpi.edu - Website: <http://www.rpi.edu/~dordick/>

Use and optimization of enzymatic catalysis in nonaqueous media (organic liquids, gases, and room temperature ionic liquids) and computational analysis and design of enzymes for

stabilization under high temperatures. Dr. Dordick is also pursuing research into potential new paper battery paradigms.

Dr. Nikhil A. Koratkar, Professor

Phone: (518) 276-2630 - Email: koratn@rpi.edu - Website: <http://www.rpi.edu/~koratn/>

Fabrication and patterning of metal and Si based nanostructures by oblique angle deposition and application in Li-ion batteries, fuel cells and solar cells

Dr. Michael K. Jensen, Professor

Phone: (518) 276-2843 - Email: jensem@rpi.edu

Website: http://www.rpi.edu/cfes/abt_r_jensen.html

Battery System Level Design and Optimization

Dr. Dan Lewis, Materials Research Center

Phone: (518) 276-2297 - Email: lewisd2@rpi.edu - Website: <http://www.rpi.edu/~lewisd2/>

Ionic transport modeling in battery materials

Dr. G. Ramanath, Director

Phone: (518) 276-6844 - Email: ramanath@rpi.edu

Synthesis, assembly, and characterization of nanostructures and thin films with emphasis on new materials and architectures for fabricating future devices for computing, energy generation and management

Dr. John Wen, Director of the NYSTAR Center for Automation Technologies and Systems

Phone: (518) 276-6156 - Email: wenj@rpi.edu - Website: http://www.cats.rpi.edu/fac_wen.html

General area of dynamic modeling, control, and motion planning for complex electromechanical systems including flexible structures, material processing systems, and network based controls. Dr. Wen is also part of a team working in battery system level design and optimization.

Li-ion Battery Development

Dr. Raymond H. Puffer, Jr., Program Director, Industrial Automation

Phone: (518) 276-8990 - Email: puffer@rpi.edu - Website: http://www.cats.rpi.edu/fac_puffer.html

Dr. Steve Rock, Research Scientist

Phone: (518) 276-3278 - Email: rocks@rpi.edu - Website: http://www.cats.rpi.edu/fac_rock.html#

Dr. Daniel F. Walczyk, Professor

Phone: (518) 276-2397 - Email: walcz@rpi.edu

Website: http://www.cats.rpi.edu/fac_walczyk.html#

Dr. Glenn Saunders, Research Engineer

Phone: (518) 276-6696 - Email: suandg@rpi.edu

Website: http://www.cats.rpi.edu/fac_saunders.html

ROCHESTER INSTITUTE OF TECHNOLOGY

Energy Storage Areas: Hybrid Power Cell Systems, Lithium Ion Batteries, Life Cycle Assessment, Nanomaterials, Remanufacturing, Sustainability, Systems Engineering

Primary Contact: Dr. Don Boyd, Vice President for Research
Phone: (585) 475-7844 - Email: donald.boyd@rit.edu

Overview

RIT has a number of on-going research programs devoted to energy storage technologies. The largest of these is focused on the use of nanomaterials to improve performance of rechargeable lithium ion batteries. There are also a number of ancillary programs examining sustainability and systems issues surrounding use of these devices. Current federal sponsors include Department of Defense, NASA, and the Department of Energy. RIT also has a number of corporate supporters and collaborators in the lithium ion battery space including A123, Lockheed Martin, Electrochem Power, TJ Technologies, Greatbatch, Alpha V / Medipac, and General Motors.

Much of this research is being conducted in the NanoPower Research Labs at RIT, which is part of the Golisano Institute for Sustainability. The mission is the transformation of global industries into sustainable enterprises by undertaking comprehensive interdisciplinary initiatives in education, research, and technology transfer. The Institute established the first Ph.D. Program in Sustainability in the world dedicated to sustainable production issues. Research on energy storage systems and rechargeable Li ion batteries in particular is part of the concentration.

Notable Centers & Facilities

NanoPower Research Labs is internationally recognized as leaders in research on nanomaterials for use in improved energy conversion and storage. The lab has developed the capabilities, experience, equipment, and nanotechnology in select focus areas which are critical to advancing renewable energy conversion and storage. NPRL facilities have grown from an initial 1,100 square foot facility in 1991 to five separate labs with a total 6,000 square feet of research space. To date, the University has contributed over \$2.3 million to support this development and lab researchers have received over \$10 million in grants and contracts and \$1 million in equipment. Website: <http://www.sustainability.rit.edu/nprl.html>

Dr. Ryne P. Raffaele, Director

Phone: (585) 475-5149 - Email: rprsps@rit.edu

Center for Integrated Manufacturing Studies was established in 1992 with a mission to increase the competitiveness of manufacturers through applied technology and training. CIMS occupies 170,000 square-feet of laboratory and office space and supports solution developments in six large, flexible manufacturing bays and more than 20 specialized technology labs. The National Center for Remanufacturing and Resource Recovery in CIMS is internationally recognized as a leading center for applied research in remanufacturing. Its mission is to deliver advanced technologies and tools to industry for efficient and cost-effective remanufacturing and design of products with no negative environmental impacts. Technologies are currently being developed for rechargeable Li ion batteries for automotive applications. Website: <http://www.cims.rit.edu/>

Dr. Nabil Nasr, Director and Assistant Provost for Academic Affairs

Phone: (585) 475-5106 - Email: nasr@rit.edu

Key Researchers & Expertise

Critical Heat Flux, Heat Transfer, and Advanced Cooling Techniques

Dr. Satish Kandlikar, Professor, Mechanical Engineering

Phone: (585) 475-6728 - Email: sgkeme@rit.edu

Website: <http://www.rit.edu/kgcoe/mechanical/people/faculty/kandlikar.htm>

The Thermal Analysis, Microfluidics and Fuel Cell Laboratory at RIT is involved in advanced water and thermal management studies in fuel cells. Dr. Kandlikar is conducting experimental, numerical and modeling studies including two sponsored projects: Visualization of Water Transport and Transport and Performance Characterization under Freezing Conditions – DOE sponsored, 2007-2010, partners include RIT, General Motors and Michigan Tech University, and Development and Integration of Novel Materials for Hydrogen Fuel Cell Applications in New York – NYSERDA sponsored, 2008-2009 with GM, RIT, Cornell and University of Rochester.

Dynamic Systems Analysis and Simulation

Dr. Tuhin Das, Assistant Professor, Mechanical Engineering

Phone: (585) 475-2139 - Email: tkdeme@rit.edu

Currently working on an Office of Naval Research funded program on the modeling, system dynamics and control of hybrid power cell systems. The purpose of this research is to optimally control the power split of a hybrid fuel cell and ultra capacitor system. Researchers are working on a system that rapidly responds to load profiles and load variations.

Multi-Criteria Decision Analysis and Life Cycle Assessments

Dr. Tom Seager, Associate Professor, Golisano Institute for Sustainability

Phone: (585) 475-6612 - Email: Thomas.Seager@rit.edu

Currently working on a National Science Foundation supported program looking at life cycle assessments of new renewable energy conversion and storage approaches. Also, Dr. Seager is performing life cycle assessment on nanomaterial utilization in Li ion rechargeable batteries.

Nanomaterial Development and Utilization in Energy Conversion and Storage

Dr. Ryne Raffaele, Director, NanoPower Research Laboratory

Phone: (585) 475-5562 - Email: rprsps@rit.edu

Website: <http://mail-pa.mcmanis-monsalve.com/projects/nprl/7/>

Currently working with Lockheed Martin, A123 Technologies, and University at Buffalo on a US Government funded program focused on using nanomaterials such as Lithium Iron (LiFe) phosphate, vanadium oxide, and carbon nanotubes to improve energy density, volumetric density, and cyclability of rechargeable lithium ion batteries. Dr. Raffaele is also working on a related program using stand-alone single walled carbon nanotube papers as Li ion battery anodes for high temperature batteries for Greatbatch and their subsidiary Electrochem Power.

Structural and Materials Analysis, Remanufacturing and Resource Recovery

Dr. Michael Haselkorn, Research Professor, Golisano Institute for Sustainability

Phone: (585) 475-5408 - Email: mhhasp@rit.edu

Website: <http://www.sustainability.rit.edu/images/haselkorn.pdf>

Currently working on program support by the Department of Transportation to develop tools and technologies for the remanufacture of Li ion battery systems.

STONY BROOK UNIVERSITY, SUNY

Energy Storage Areas: Advanced Batteries, Capacitors, Fuel Cells, Hydrogen Generation and Storage, Li-ion Batteries, Modeling of Lithium Ion Transport, Structure Analysis at Synchrotron/Neutron Scattering Facilities

Primary Contact: Dr. Ann-Marie Scheidt, Director of Economic Development
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Overview

Stony Brook has extensive experience in nanotechnology and energy research. In particular Stony Brook is under contract for nanotechnology research at Argonne National Laboratory, National Institute of Standards and Technology, and Lawrence Berkeley National Laboratory. Stony Brook also co-manages Brookhaven National Lab.

Ground breaking for Stony Brook's new \$35 million Advanced Energy Research and Technology Center in renewable energy occurred in October 2007. The Center is the umbrella organization responsible for energy research and storage technologies at Stony Brook. AERTC is partnering with 13 regional colleges and universities, Brookhaven National Lab, and more than a dozen private companies including IBM, National Grid, Northrop Grumman and Computer Associates. A complete summary of energy research projects at Stony Brook is available at <http://www.cewit.org/docs/energyprojects.pdf>

Centers & Facilities

Advanced Energy Research and Technology Center will promote research in five areas which leverage the participant's expertise in nanotechnology and are aligned with recommendations from the Department of Energy's NanoScience in Energy Summit (Website: <http://www.aertc.org/>):

- Renewable energy: wind, water, geothermal, ocean, biomass; and nanotechnology applied to make powerful photovoltaic cells
- Hydrogen energy: generation, processing, storage; methane hydrate mining; and nanotechnology applied to processing and storage
- Fuel cells: SOFC/PEM fuel cells and nanotechnology applied to catalytic particles for cell membranes
- Conventional fuel optimization: emissions-free coal-burning plants; liquefied natural gas storage, transport, monitoring; nanotechnology applied to LNG delivery and to SOx/NOx filtration
- Energy conservation: high-efficiency experimental houses; computational techniques to optimize the power grid

The **Center for Advanced Technology in Sensor Systems** is a NYSTAR-designated Center for Advanced Technology to work with industry on production and product development challenges where sensors can improve performance and applications. The center has expertise in magnetic, optical, X-ray and infrared sensors and work is underway in super-conducting electronics and MEMS-based sensors and actuators. Website: <http://www.sensorcat.sunysb.edu/>

Key Researchers & Expertise

Advanced Batteries

Dr. Clare Grey, Associate Director, Center for Environmental Molecular Sciences and Brookhaven National Lab Co-Appointee

Phone: (631) 632-9548 - Email: Clare.Grey@sunysb.edu

Website: <http://www.sunysb.edu/chemistry/faculty/cgrey.htm>

Dr. Grey and her research team was retained at Stony Brook with funding from NYSTAR's Faculty Development program and concentrates in several areas of battery research including:

Alkaline Batteries for Primary Batteries - In a long-standing collaboration with workers at Duracell, Dr. Grey's lab is using solid-state nuclear magnetic resonance (NMR) methods to elucidate the reduction mechanisms that occur during discharge of a 1.2 V alkaline battery. Their work on Li-exchanged manganese oxides helped scientists at Duracell optimize synthesis of electrolytic manganese oxide – the cathode used inside the alkaline battery. This has led to an improved manganese oxide for this application, which is being produced by Duracell.

Lithium Batteries for High-Power Applications – Dr. Grey's lab is engaged in a joint synthesis and characterization program aimed at understanding how electrode materials (anodes and cathodes) function, why they fail, and how to make better materials. In particular, they are using solid-state lithium NMR to track the Li ions as they move through the lattices. Current DOE-supported work focuses on the cathode material $\text{Li}(\text{NiMn})_{0.5}\text{O}_2$. This material is of particular interest, because it is free of cobalt, unlike the commercial Li-ion battery, which uses LiCoO_2 as the cathode. Cobalt is undesirable both from a toxicity and cost standpoint. Their joint research program with collaborators at MIT has led to an improved cathode material with much higher discharge and charge rates. In a related program supported by an NSF Approaches to Combating Terrorism Grant, Dr. Grey's lab is synthesizing and characterizing nanoparticles of LiCoO_2 , $\text{Li}(\text{NiMn})_{0.5}\text{O}_2$ and related materials. The smaller nanoparticles are expected to show much higher rate capabilities, and may be suitable for hybrid electric vehicle (HEV) applications.

Dr. Benjamin Chu, Distinguished Professor, Department of Chemistry

Phone: (631) 632-7928 - Email: benjamin.chu@sunysb.edu

Website: <http://www.sunysb.edu/chemistry/faculty/bchu.htm> or <http://www.bnl.gov/NSLS/X27C/Chu.htm>

Authority on laser light scattering in the frontiers of light scattering and synchrotron small angle X-ray scattering techniques along with integration of mechanical and spectroscopic measurements and processing methods

Energy Control Systems

Dr. Lei Zuo, Department of Mechanical Engineering

Phone: (631) 632-9327 - Email: Lei.Zuo@sunysb.edu

Website: <http://me.eng.sunysb.edu/faculty/LeiZuo.php>

Dr. Zuo's research interests include passive and active vibration control, energy harvesting, dynamic systems and control, and mechatronics system design including developing new methods to control vibration and attain more useful energy.

Energy and Environmental Life-Cycle Analysis

Dr. Sheldon Reaven, Graduate Program Director, Department of Technology and Society

Phone: (631) 632-8768 - Email: Sheldon.Reaven@sunysb.edu

Hydrogen Storage

Dr. James Davenport, Adjunct Professor and Director of the Computational Science Center at Brookhaven National Laboratory

Phone: (631) 344-3789 - Email: jdaven@bnl.gov

Dr. Davenport is researching hydrogen storage using quantum level calculations to determine the amounts and energetics of storage in various metals to design efficient compounds to effect the storage. The calculations will determine the energy of absorption of hydrogen into finite clusters of palladium as a first step. Also planned is the study of mixtures, especially ones less costly and of lower weight, for practical hydrogen storage in automotive applications.

Dr. Devinder Mahajan, Department of Materials Science and Engineering and Brookhaven National Laboratory Co-Appointee

Phone: (631) 632-1813 - Email: Devinder.Mahajan@sunysb.edu

Energy research includes methane hydrates, hydrogen production, fuel cells, Fischer-Tropsch, methanol, and mixed alcohol synthesis using soluble (single-site) or slurry (nano heterogeneous or colloidal phase) based catalysts

Modeling of Lithium Ion Transport During Battery Cycling

Dr. Dilip Gersappe, Department of Materials Science and Engineering and Brookhaven National Laboratory Co-Appointee

Phone: (631) 632-7642 - Email: dilip.gersappe@sunysb.edu

Website: <http://www.matscieng.sunysb.edu/gersappe1.html>

Statistical mechanical and computer modeling of complex chemical systems. Dr. Gersappe is investigating the behavior of self-assembling polymeric and biopolymeric systems and the properties of polymers at surfaces and interfaces.

Nanoelectronics

Dr. Konstantin Likharev, Distinguished Professor, Department of Physics

Phone: (631) 632-8159 - E-mail: klikharev@notes.cc.sunysb.edu

Website: <http://pavel.physics.sunysb.edu/~likharev/personal/>

Research includes device and circuit concepts for ultralow power, hybrid CMOS / nanoelectronic circuits, and extremely low power hybrid silicon - nanoelectronic circuits

Polymers, Storage, and Materials

Dr. Benjamin S. Hsiao, Professor, Department of Chemistry

Phone: (631) 632 7793 - Email: bhsiao@notes.cc.sunysb.edu

Website: <http://www.sunysb.edu/chemistry/faculty/bhsiao.htm> or <http://www.bnl.gov/nsls/x27c/hsiao.htm>

Dr. Hsiao's Nanofibrous Membranes for Energy Applications research aims to develop new nanostructured materials for energy storage device applications by combining the multiple-jet electro-spinning/blowing technology with novel chemical and physical pathways to prepare functional organic/inorganic nanocomposite membranes. The new format should have unique electrical conducting and mechanical properties with applications to batteries (new anodes and cathodes) and fuel cells (catalyst support membranes).

Dr. Tadanori Koga, Department of Chemical and Molecular Engineering

Phone: (631) 632-8485 - Email: tkoga@notes.cc.sunysb.edu

Dr. Koga's research interest is the development of green nanofabrication of polymer thin films using supercritical carbon dioxide and methane hydrate as a future energy resource. The key for these projects lies in the development of rational design strategies. For this purpose, he has

been integrating a variety of in-situ and real-time x-ray/neutron/light scattering techniques for both surface/interface and bulk/solution structure analysis at synchrotron/neutron scattering facilities including the National Synchrotron Light Source at Brookhaven, Advanced Photon Source at Argonne National Lab, and National Institute of Standards and Technology. He also focuses on self-assembling processes of soft matter systems (polymers, colloids, gels, membranes) under various external stimulants for achieving a fundamental understanding to bring the concept into commercial applications.

SYRACUSE CENTER OF EXCELLENCE IN ENVIRONMENTAL & ENERGY SYSTEMS

Energy Storage Areas: Ground-Source Heating and Cooling, Solar Thermal Collection Systems for Commercial and Residential Buildings

Primary Contacts: Dr. Ed Bogucz, Jr., Executive Director, Syracuse CoE
Phone: (315) 443-4445 - Email: ebogucz@syracusecoe.org

Dr. Ez Khalifa, Director Environmental Quality Systems STAR Center
Phone: (315) 443-1286 - Email: hekhalif@syr.edu

Overview

The Syracuse Center of Excellence in Environmental and Energy Systems (Syracuse CoE), includes the Environmental Quality Systems STAR Center, and is a consortium of ten academic institutions and two not-for-profits. The STAR Center is a NYSTAR-designated Center to work with industry on production and product development challenges related to environmental and energy systems. Research includes clean and renewable energy, indoor air quality and comfort, lighting, acoustics/intelligent controls, built environment systems, environmental science and engineering, human health/performance, intelligent control/management, thermo-fluids, and water management. The centers are catalysts for collaborations among 100+ researchers in environmental systems. Websites: <http://www.syracusecoe.org/> or <http://www.eqstar.org/index.aspx>

Centers & Facilities

The Syracuse CoE headquarters is a 55,000-square-foot facility under construction in downtown Syracuse, scheduled to open in September 2009. It will serve as a test bed for new energy and environmental systems and commercial energy storage systems. The Syracuse CoE also is active in a major community initiative in Syracuse's Near West Side neighborhood, including providing opportunities to test residential energy storage systems in real-world situations.

Syracuse CoE also has labs and equipment for testing energy storage systems including the Building Energy and Environmental Systems (BEES) Laboratory at Syracuse University, a first-of-its-kind full-scale thermal and air quality testing lab with two independent chambers to adjust for different air temperature, humidity, velocity, and composition for testing and simulation of materials and systems. Website: <http://beesl.syr.edu/pdf/BEESL.pdf>

Key Researchers & Expertise

The center's research and development occurs through collaboration between researchers throughout New York State. Specifically at this facility, work is underway in:

- Storing thermal energy for hot water from solar thermal collectors for use at night or during cloudy periods. Test bed deployment of a system is expected in 2009.
- Ground-Source Heating and Cooling Systems – the new Syracuse CoE headquarters will use a ground-source heating and cooling system that will be available for testing new components in real-time and under actual operating conditions.

SYRACUSE UNIVERSITY

Energy Storage Areas: Sensors and Control Systems, Thin Films

Primary Contacts: Dr. Gina Lee Glauser, Associate Vice President for Research
Phone: (315) 443-1824 - Email: leeglaug@syr.edu

The NYSTAR-designated Center for Advanced Systems and Engineering focuses on computer applications and software engineering applications. Current research includes control systems, systems modeling and analysis, systems assurance, intelligent computing, and sensor networks that could assist with energy storage management systems. Website: www.case.syr.edu

Dr. Pramod Varshney, Director

Phone: (315)443-4013 - Email: varshney@syr.edu

Dr. Varshney's research includes distributed sensor networks and data fusion, wireless communications, image processing, signal processing and parallel algorithms.

Dr. Duane Marcy, Assistant Professor

Phone: (315) 443-2119 - Email: dlmarcy@syr.edu

Website: http://lcs.syr.edu/academic/dept_electricalengcompsci/facultystaff_research.aspx?id=1917

Semiconductor manufacturing, thin films for semiconductor-protein based devices

COLLEGE OF NANOSCALE SCIENCE & ENGINEERING – UNIV. AT ALBANY, SUNY

Energy Storage Areas: Advanced Batteries, Flow Batteries, Fuels Cells, Microelectronics, Measurements and Modeling, Nanostructured Materials, Power Electronics, Sensors, Super Capacitors

Primary Contact: Dr. Pradeep Halder, Director, E2TAC
Phone: (518) 437-8686 - Email: phalder@uamail.albany.edu

Overview

The College of Nanoscale Science and Engineering at University at Albany comprises a \$4.5 billion, 450,000-square-foot complex for research, development, prototyping, pilot manufacturing and education for semiconductors and nanoelectronics. CNSE houses a fully-integrated, 300mm wafer, computer chip pilot prototyping and demonstration line. An expansion currently underway will increase the size of the complex to over 800,000 square feet, including over 80,000 square feet of Class 1 cleanroom space, to house over 2,500 scientists, researchers, engineers, students, and faculty.

Centers & Facilities

Energy and Environmental Technology Applications Center (E2TAC) is the principal energy research institute and was created in 1998. It was established as an active expansion of the College of Nanoscale Science & Engineering to work with companies in the rapidly emerging energy and environmental industries. E2TAC provides a critical platform for the Albany Nanotech Complex to leverage its intellectual power base and state-of-the-art infrastructure to provide an applications-targeted, resource supporting technology development, leading to the integration of microelectronics and nanotechnology in advanced energy and environmental applications. The center serves as the energy component of the NYSTAR-designated Center for Advanced Technology in Nanotechnology and Nanoelectronics. Website: <http://www.e2tac.org/>

Technology Development

Electric Double Layer Capacitors (EDLCs)

EDLCs are electric storage devices that serve a similar function as batteries and are also referred to as ultra capacitors or super capacitors. EDLCs consist of two electrodes (a thin layer of carbon deposited on metal foil current collectors) electrically isolated from each other by a thin separator. The electrodes and separator are immersed in a liquid electrolyte. EDLCs store energy by grouping positively charged ions in the electrolyte with electrons in the negative electrode (and negative ions with electron holes in the positive electrode). This allows much faster charging and discharging than batteries, which store energy through electrochemical reactions. The energy density in EDLCs has been greatly increased since their early development due to high surface achieved with activated carbon electrodes; up to half an acre of surface area per gram of carbon (about the weight of a paper clip). In addition to high power density, EDLCs can recharge quickly, have significantly longer cycle lifetime, can withstand harsher environments, and do not contain toxic components. By developing materials that boast bigger surface areas for batteries, there is more space for electrons to flow between each end of the device and ultimately more power. E2TAC is using several techniques to improve EDLC performance including:

- *High specific capacitance electrodes using Carbon Nanostructures (CNTs) and Carbon Nanofibers (CNFs):* Carbon nanostructures offer several advantages in EDLC electrodes over conventional activated carbon. For example, CNTs have fewer functional groups than activated carbon, and therefore cause electrolyte breakdown at higher voltages. Because EDLC's energy storage is proportional to the square of the maximum voltage, these electrodes can lead to high-energy-density EDLCs. Also, CNTs are highly conductive, which results in lower equivalent series resistance and higher power density.
- *Low equivalent series resistance electrode-current collector mating techniques:* One component of equivalent series resistance is the interface between the electrode and current collector. E2TAC is developing conformal techniques to reduce the equivalent series resistance between these two components.
- *Fabrication of novel ionic liquid electrolytes for larger voltage windows:* E2TAC has synthesized a number of ionic liquid electrolytes. These can offer significant advantages over conventional electrolytes including higher breakdown voltage and wider operating temperature range.

- *Optimizing ion-pore matching using Raman analytical techniques:* E2TAC is using Raman techniques to characterize the interactions between electrodes and electrolytes.

Power Electronics

E2TAC researchers have developed integrated cryogenic power modules for use in high performance inverters. Specific areas of E2TAC research include:

- Cryogenic qualification of packaging components and materials (substrates, die-attach, wire bonds, encapsulation)
- Thermal, mechanical, and electrical modeling of power components at cryogenic temperatures
- Design and prototyping of integrated power modules and qualification and testing
- Fabrication of integrated modules for cryo-inverter demonstrations
- 3-D packaging development with goal to eliminate wire bonds and increase reliability
- Novel Power Electronics Devices
- Using numerical simulations and proof-of-principle experimentation to investigate the potential of new high-performance device designs that are intended to provide superior I-V characteristics to current power MOSFETs (metal-oxide semiconductor field-effect transistor) or IGBTs (Insulated-Gate Bipolar Transistors) used in power electronics. The power electronics systems are used to integrate power systems including energy storage systems and technologies.

Sensors

Research is underway to integrate chemical sensors into system-on-a-chip technology platforms that enable a cost effective and reliable solution for energy and environmental monitoring applications including performance of batteries, capacitors and other storage systems especially in harsh environmental conditions. E2TAC is developing field deployable, tailored sensing solutions for hydrocarbons, harsh environment and sensor systems through the use of optical, electrical or acoustical sensing platforms. A major research focus area for integrated chemical sensors is the development of materials with the required selectivity, specificity and reliability for the targeted sensing application. E2TAC utilizes a tailored design methodology using the unique properties of nanomaterials for the development of an optimized sensing platform.

Key Researchers and Expertise

Main Phone: (518) 437-8686 Website: <http://www.e2tac.org/people/staff.html>

Dr. Pradeep Halder, Director, E2TAC

Email: phalder@uamail.albany.edu

Hydrogen storage, power semiconductors, thermoelectric materials, super capacitors and superconductors

Fuel Cells

Dr. John Elter, Empire Innovation Professor of Nanoengineering and Executive Director of the Center for Sustainable Ecosystem Nanotechnologies

Phone: (518) 860-0300 - Email: jelter@uamail.albany.edu

Electro-mechanical and electro-chemical processes at the nanoscale level with application to sustainable ecosystems at the material, device and system level. Prior to joining CNSE, Dr. Elter served as Chief Technology Officer at Plug Power.

Grid-Connected Solar Energy Storage Using Zinc-Bromine Flow Battery

Dr. Richard Perez, Senior Research Associate

Email: perez@asrc.cestm.albany.edu

Nanomaterial Characterization

Dr. Kathleen Dunn, Assistant Professor of Nanoscience

Email: KDunn1@uamail.albany.edu

Dr. Harry Efstathiadis, Assistant Professor of NanoEngineering

Email: HEfstathiadis@uamail.albany.edu

Thermoelectric materials, processing of nanostructures

Dr. Eric Lifshin, Director, Metrology and Electron Imaging, Professor NanoSciences

Email: ELifshin@uamail.albany.edu

Analysis of nanostructured materials

Dr. James Raynolds, Assistant Professor of Nanoscience

Email: jraynolds@uamail.albany.edu

Modeling at the molecular level

Sensors

Dr. Michael Carpenter, Assistant Professor, NanoEngineering

Email: MCarpenter@uamail.albany.edu

Thin Film Processing of Nanomaterials for Power Electronics Materials

Dr. Shadi Shahedipour-Sandvik, Assistant Professor of Nanoengineering

Email: sshahedipour@uamail.albany.edu

Dr. Joyce Zhao, Research Scientist

Email: zzhao@uamail.albany.edu

Fabrication and testing of devices

Ultra Capacitors

Dr. Manisha Rane-Fondacaro, Materials Scientist

Email: mrane@uamail.albany.edu

UNIVERSITY AT BUFFALO, SUNY

Energy Storage Areas: Advanced Batteries, Electronic Packaging and Reliability Testing, Electromigration, Fuel Cells, Nanomaterials, Power Systems for Medical Devices, Thermomigration

Primary Contact: Dr. Jorge José, Vice President for Research

Phone: TBD - Email: TBD

Website: <http://www.research.buffalo.edu/>

Overview

University at Buffalo is home to world-leading research centers in areas ranging from bioinformatics to homeland security, with the New York State Center of Excellence in Bioinformatics and Life Sciences as their centerpiece. As a research-intensive university, the

University seeks knowledge that will lead to new cures, improved processes, stronger materials, faster computers, smarter software, and enhanced power systems for medical devices.

Energy storage technologies available for licensing including the following can be found on the University's Technology Transfer Website at: <http://www.research.buffalo.edu/stor/industry/search.cfm>

- Highly Effective Li₂O/Li₃N with Ultra-fast Kinetics for H₂ Storage
- High Reversible-Hydrogen Storage Capacity with Ultra-fast Kinetics of LiNH₂/Li₃N
- Synthesis and Stabilization of Metal Nanoparticles
- Ultra-fast synthesis of a hydrogen storage material Li₂NH
- Chalcogenoxanthylum Dyes as Photosensitizers for Photoinduced Charge Transfer
- Electrical Energy Generator with Integrated Thermoelectric, Solar and Battery Capabilities

Centers & Facilities

Energy Storage and Conversion is a primary strength within the University's Integrated Nanostructured Systems UB 2020 Strategic Initiative. Nanomaterials and nanostructures provide the enabling technology for the adoption of electric vehicles (EVs) or plug-in hybrid electric vehicles (PHEVs). New generations of medical devices are also being developed to provide novel forms of therapy and continuous monitoring of key physiological parameters. Widespread adoption of these approaches would be facilitated by smaller devices with improved energy storage capabilities to provide the physician greater flexibility in implant location. A complete list of participating researchers can be found at: http://ub2020.buffalo.edu/ins/faculty/research/research_interests.php?sid=7

Key elements of regenerative fuel cells are also being developed. A promising approach involves the photocatalytic production of solar "fuels" through the cleavage and formation of chemical bonds. In this process, solar energy is used to drive non-spontaneous reactions, such as "water splitting" or the formation of H₂ and O₂ from H₂O. When coupled with advancing fuel cell technology, efficient production of electrical energy from solar fuels is being investigated.

Dr. Mark T. Swihart, Director, Integrated Nanostructured Systems Strategic Initiative
Phone: (716) 645-2911, ext. 2205 - Email: INSdirector@eng.buffalo.edu

The **Center for Advanced Technology in Biomedical and Bioengineering Technology** is a NYSTAR-designated Center for Advanced Technology to work with industry on production and product development challenges related to biomedical applications, diagnostics, and devices. While the center's core focus is medical applications, their bioengineering work may also include areas important to advanced battery development for medical devices. The Center's Director, Dr. Esther Takeuchi, is an expert in advanced batteries and profiled below.

Website: <http://www.research.buffalo.edu/stor/funding/cat.cfm>

Key Researchers & Expertise

Advanced Batteries

Dr. Esther Takeuchi, Greatbatch Professor of Advanced Power Sources
Department of Chemical and Biological Engineering; Department of Electrical Engineering,
Phone: (716) 645-2911, ext. 2209 - Email: et23@buffalo.edu
Website: <http://www.cbe.buffalo.edu/takeuchi.htm>
Research focus on Nanomaterials for batteries; implantable medical devices; energy conversion

and storage. Dr. Takeuchi is believed to have more patents than any other woman and is credited with designing and developing life-changing technologies such as leading the development of an efficient battery for the implantable defibrillator, the pacemaker, drug-delivery devices and neurostimulators. Dr. Takeuchi was previously Director of Battery Research and Development at Greatbatch Technologies.

Advanced Materials and Nanoelectronics

Dr. Sarbajit Banerjee, Associate Professor of Chemistry

Phone: (716) 645-6800, ext. 2124 - Email: sb244@buffalo.edu

Website: <http://www.chem.buffalo.edu/banerjee.php>

Synthesis and surface chemistry of oxide nanoparticles; directed assembly and device integration of nanoparticles, nanowires, and carbon nanotubes; functional nanocrystal films for gate dielectric and photovoltaics; raman spectroscopy and XANES characterization.

Dr. Alexander N. Cartwright, Professor of Electrical Engineering

Phone: (716) 645-1053 - Email: anc@buffalo.edu

Website: <http://www-ee.eng.buffalo.edu/faculty/ca...>

Ultrafast optical properties of materials and devices; semiconductor quantum dots and hybrid inorganic / organic materials and devices; biophotonics: biological and chemical sensors; optical non-destructive testing; nanophotonics and nanoelectronics.

Dr. Deborah D.L. Chung, Niagara Mohawk Chair Professor of Material Research Mechanical and Aerospace Engineering

Phone: (716) 645-2593, ext. 2243 - Email: ddlchung@buffalo.edu

Website: <http://alum.mit.edu/www/ddlchung>

Application of materials science and engineering to develop, improve, test and understand advanced material properties and new applications

Dr. Michael W. McKittrick, Associate Professor of Chemical and Biological Engineering

Phone: (716) 645-2911, ext. 2217 - Email: Mm355@buffalo.edu

Website: <http://www.cbe.buffalo.edu/mckittrick.ht...>

Design and synthesis of photofunctional materials; molecular design; catalysis; solid supported organometallic compounds

Electronics Packaging and MEMS

Dr. Cemal Basaran, Professor and Director of Electronic Packaging Lab

Phone: (716) 645-2114, ext. 2429 - Email: cjb@buffalo.edu

Website: <http://www.packaging.buffalo.edu>

Electronic packaging; electromigration; thermomigration; electronics reliability

Dr. Kwang W. Oh, Assistant Professor of Electrical Engineering

Phone: (716) 645-1025 - Email: kwangoh@buffalo.edu

Website: <http://www.SMALL.buffalo.edu>

BioMEMS; Lab-on-a-Chip; Micro Total Analysis Systems (uTAS); Micro/nanofluidics; nanobiosensors; microactuators

Dr. Yong Kyu Yoon, Assistant Professor of Electrical Engineering

Phone: (716) 645-1029 - Email: ykyoon@eng.buffalo.edu

Website: <http://www.ee.buffalo.edu/MnML>

Micro/nano-biomedical device fabrication; wireless power transfer using RF and microwave

Dr. Bernard A. Weinstein, Professor of Physics

Phone: (716) 645-2017, ext. 153 - Email: phyberni@buffalo.edu

Website: <http://www.physics.buffalo.edu/weinstein...>

Optical and high-pressure studies of vibrational and electronic properties of semiconductor nanostructures; effects of nanoscale geometry on phase stability; confined effects and coupled excitations for lattice modes and electronic levels; impurity and defect states

Molecular Simulation and Modeling

Dr. Jeffrey R. Errington, Associate Professor of Chemistry and Biological Engineering

Phone: (716) 645-2911, ext. 2222 - Email: jerring@buffalo.edu

Website: <http://www.cbe.buffalo.edu/errington>

Molecular simulation; molecular thermodynamics; statistical mechanics

Dr. David A. Kofke, Chair and Professor of Chemistry and Biological Engineering

Phone: (716) 645-2911, ext. 2215 - Email: kofke@buffalo.edu

Website: <http://www.cbe.buffalo.edu/kofke>

Molecular simulation methods; diffusion in solids; crystal polymorphism; software engineering

Polymers

Dr. Paras N. Prasad, SUNY Distinguished Professor and Samuel P. Capen Chair SUNY Distinguished Professor and Samuel P. Capen Chair

Phone: (716) 645-6800, ext. 2099 - Email: pnprasad@buffalo.edu

Website: <http://www.photonics.buffalo.edu>

Polymers; photonics; biophotonics; optics

Dr. Javid Rzaev, Assistant Professor of Chemistry

Phone: (716) 645-6800, ext. 2237 - Email: jrzayev@buffalo.edu

Website: <http://www.chem.buffalo.edu/rzayev.php>

Novel synthetic approaches in polymer chemistry; polymer self-assembly; macromolecules

UNIVERSITY OF ROCHESTER

Energy Storage Areas: Advanced Batteries, Fuel Cells, Hydrogen Storage

Primary Contact: Dr. Gail M. Norris, Director Office of Tech Transfer, Medical Campus

Phone: (585) 275-5370 - Email: gail.norris@rochester.edu

Overview

The University of Rochester is a top research university recognized as leader in world class imaging, medicine, and science. The University is home to the University of Rochester Medical Center, The Center for Advanced Technology in Electronic Imaging Systems, and the Nanoelectronic Design of Electronic Imaging Systems.

Centers & Facilities

The Department of Electrical and Computer Engineering conducts research into areas that include low energy sensing, computing and capacitors. The **Center for Advanced Technology in Electronic Imaging Systems** is a NYSTAR-designated Center for Advanced Technology to work

with industry on production and product development challenges related to electronic imaging, nanotechnology, and components. A nanoelectronic design component focuses on improving the current condition in microelectronic circuit design and enabling development of new and improved integrated circuits. <http://www.ceis.rochester.edu/> The University also hosts the world's most powerful ultraviolet laser for investigation of intense radiation with matter.

Website: <http://www.lle.rochester.edu/>.

Key Researchers & Expertise

Advanced Batteries and Fuel Cells

Dr. Jacob Jorne, Professor of Chemical Engineering

Phone: (585) 275-4584 - Email: jorne@che.rochester.edu

Website: <http://www.che.rochester.edu/jorne.htm>

Advanced batteries including lithium-ion batteries and regenerative fuel cells

Fuel Cells

Dr. Philippe Fauchet, Distinguished Professor of Electrical and Computer Engineering

Phone: (716) 275-4066 - Email: fauchet@ece.rochester.edu

Website: <http://www.ece.rochester.edu/~fauchet/>

Examining using silicon as a potential for fuel cell proton exchange membrane

Hydrogen Storage

Dr. Ben Ebenhack, Senior Lecturer Chemical Engineering

Phone: (585) 275-9209 - Email: bwe@che.rochester.edu

Website: <http://www.che.rochester.edu/ebenhack.htm>

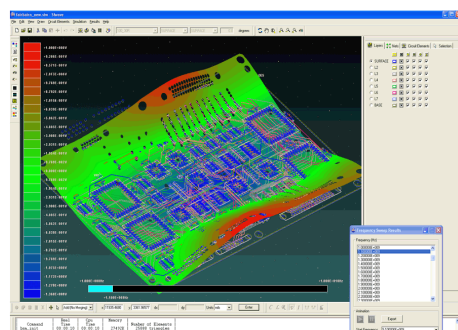
Chemical hydrogen storage via sodium borohydride systems and expertise and research in natural gas storage in underground reservoirs and the evaluation of reservoirs

NEW YORK'S HIGH PERFORMANCE COMPUTING RESOURCES

According to the Top 500 Supercomputing Sites, two of the world's fastest supercomputers are at New York institutions: Brookhaven National Laboratory/Stony Brook University in Long Island and Rensselaer Polytechnic Institute in Troy. As a result of New York's investment in these facilities, the State has the ability to direct portions of the computational power at each facility.

<http://www.nystar.state.ny.us/hpcapp.pdf>

In addition, a newly-formed **New York State High Performance Computing Consortium** links these supercomputers with facilities at other New York institutions. Computational programming assistance is also available to help companies and researchers with modeling and simulation. This will enable combined use of each facility's resources for modeling, simulation, prototype development and testing.



Brookhaven National Lab/Stony Brook University Supercomputer

The **Brookhaven National Laboratory - Stony Brook University Supercomputer**, dubbed New York Blue, has more than 36,000 processors for a total of 103 teraflops (103 trillion calculations/second or 10,000 times faster than a standard PC). Blue Gene is also the most energy-efficient system offering more performance per watt at a fraction of the energy needed to cool most systems.

Supported by a \$26-million allocation from New York State, New York Blue is the centerpiece of the Center for Computational Sciences, a cooperative initiative between Stony Brook and Brookhaven to foster research collaborations among institutions, universities and companies throughout the State to develop applications in new technologies.

<http://www.nystar.state.ny.us/nyccs.pdf>



RPI Supercomputer System

Announced in May 2007, the **RPI supercomputer** system is a \$100 million partnership between RPI, IBM and New York State to advance the science, engineering and manufacturing of nanoscale materials, devices and systems.

The system operates massively-parallel IBM Blue Gene supercomputers, Power-based Linux clusters and AMD Opteron processor-based clusters to provide up to 70 teraflops of computational power and associated networking and storage.

Specifically, this system will be used for new generations of modeling and simulation methods aimed at dramatically reducing the time and cost of design for devices and products that depend on the control of nanoscale processes.

<http://www.nystar.state.ny.us/ccni.pdf>

For information on accessing these facilities, please contact Michael Ridley, Director of High Performance Computing, at NYSTAR (518-292-5700 or mridley@nystar.state.ny.us).

APPENDIX 1 - NEW YORK COMPANIES IN ENERGY STORAGE & COMPONENTS

For any omissions or updates, please contact NYSTAR at (518) 292-5700.

Advanced Energy Conversion – Schenectady, NY

Founded in 1997 by Chief Technology Officer David Torrey, a former RPI professor, and Jim Kokernak, one of his former graduate students; primary product is an inverter that converts energy from solar panels from direct current into alternating current

Dr. David A. Torrey, Chief Technology Officer

Phone: (518) 289-8020, x11 - Email: DavidTorrey@AdvancedEnergyConversion.com

BAE Systems – Johnson City, NY

Thomas Webb, Marketing Mgr

Phone: (413) 253-2564 or (617) 899-2679 - Email: thomas.webb@baesystems.com

Bren-Tronics Inc. - Commack, NY

Design and manufacturing rechargeable batteries and charging systems

Leo A. Brenna, CEO

Phone: (631) 499-5155

Website: <http://www.bren-tronics.com>

Brookhaven Technology Group - Setauket, New York

A science and engineering company working in isomer energy storage systems and nanoparticle energy storage based on the surface tension energy of nano-particles

Dr. J. Paul Farrell, President

Phone: (631) 941-9177 - E mail: mary@btg.cc

Website: http://www.btg.cc/projects/isomer_energy_storage.php

Corning Inc. - Corning, NY

World leader in specialty glass and ceramics for consumer electronics, mobile emissions control, telecommunications and life sciences

Paul Marx, Director of Business Development

Phone: (607) 974-3313 - Email: MarxP@corning.com

Website: <http://corning.com>

Custom Electronics, Inc. – Oneonta, NY

Subsidiary of Renewable Energy Development Inc. (REDI); manufactures and develops capacitors

Michael Pentaris, CEO

Phone: (607) 432-3880 x202 - Email: mpentaris@customelec.com

Website: <http://customelec.com>

Dayton T. Brown – Bohemia, New York

World-class testing capabilities for a variety of applications and devices including energy storage, automotive, defense, aviation, consumer products and electronics, transportation, transit, medical, and telecom.

David Mroczka, Senior Vice President & General Manager - Engineering & Test Division

Phone: (631) 244-6266 - Email: dmroczka@dtbtest.com

Website: www.dtbtest.com

Delphi Corp. – Rochester, New York

Mobile electronics and transportation systems including powertrain, safety, thermal, control and security systems, fuel cells, hybrid electric vehicles and battery packs

Steven Shaffer, Chief Engineer, Fuel Cell Development

Phone: (585) 359-6615 - Email: Steven.Shaffer@delphi.com

Delphi Corporation – additional contact

Gary D. Blake, Program Manager

Phone: (585) 359-6187 - Email: Gary.D.Blake@delphi.com

Website: <http://delphi.com/manufacturers/>

Electrochem Solutions Inc. - Clarence, NY

Created from the lithium battery invented for the implantable pacemaker by Greatbatch; offers customized battery power and wireless sensing solutions

Website: <http://www.electrochemsolutions.com>

Electrovaya – Malta, NY

Developer and manufacturer of portable power solutions with proprietary Lithium Ion SuperPolymer® battery technology.

Dr. Sankar Das Gupta, CEO

Phone: (905) 855-4611 - Email: sdasgupta@electrovaya.com

Website: <http://www.electrovaya.com/>

Electrosynthesis – Lancaster, NY

Development of electrochemical technologies for energy storage systems, fuel cells, electrodialysis, separations, sensors, synthesis of inorganic and organic chemicals and recycling of waste streams; offers a range of fuel cell and battery testing capabilities.

Dr. David Genders, President & CEO

Phone: (716) 684-0513 x 121 - Email: david.genders@electrosynthesis.com

Website: www.electrosynthesis.com

ENrG – Buffalo, NY

Development and manufacture of ceramic membrane and coating technologies for energy applications such as solid oxide fuel cells and gas separation

John Olenik, President

Phone: (716) 390-6740 - Email: JOlenick@enrg-inc.com

Website: <http://www.enrg-inc.com/>

EnergyHub - Brooklyn, New York

Product gives consumers the ability to monitor and control their home energy use, reduce electricity consumption, and save money while allowing utilities the ability to better manage peak loads and extend demand response to residential customers on a wide scale.

Seth Frader-Thompson, CEO and Co-Founder

Phone: (718) 522-7051 - E-mail: frader@energyhub.net

Website: <http://www.energyhub.net/Home.html>

General Electric Global Research – *Niskayuna, NY*

Energy generation and storage systems

Dr. Glen Merfeld, Mgr, Chemical Energy Systems Laboratory

Phone: (518) 387-6810 - Email: merfeld@research.ge.com

Website: <http://www.ge.com/research/>

General Motors – *Honeoye Falls, New York*

Fuel cell and battery development

Contact: Matt Fronk, Director

Phone: (585) 624-6601 - Email: Matthew.Fronk@gm.com

Greatbatch Technologies – *Clarence, NY*

Implantable medical devices and storage components

Thomas Hook, President & CEO

Phone: (716) 759-5600

Website: www.greatbatch.com

IBM Research – *Yorktown Heights, New York*

Stephen Rossnagel

Phone: (914) 945-1503 - Email: rossnag@us.ibm.com

Additional contact:

Richard Haight

Phone: (914) 945-3805 - Email: rahaight@us.ibm.com

K&G Power Systems - *Hauppauge, New York*

Compressed air systems and energy solutions including microturbine cogeneration and variable frequency drives

John Gandolfo, Jr., President

Phone: (631) 342-1171 - Email: johng@kgpowersystems.com

Website: <http://www.kgpowersystems.com/>

Lockheed Martin – *Liverpool, NY*

New Molecular Platforms and Architectures for Electrical Energy Storage

Joe Casper, Strategic Research & Technology Development

Phone: (315) 456-4035 - Email: joseph.r.casper@lmco.com

McQuay Applied Terminal Systems (subsidiary of Daikin) – *Auburn, NY*

Commercial, industrial and institutional HVAC systems and one of the last domestic heat pump manufacturers producing systems for geothermal energy production

Jim Cullen, General Manager

Phone: (315) 282-6308

Website: <http://www.mcquay.com>

Memory Protection Devices – *Farmingdale, NY*

Electronic components and battery casing systems

Phone: (631) 249-0001

Website: www.batteryholders.com

Momentive Performance Materials – Albany, NY

Silicone encapsulants for lithium compounds and silicone sealing technologies for batteries

Jonathan Rich, President & CEO

Phone: (518) 533-4600

Website: www.momentive.com

Northrop Grumman Systems Corporation – Bethpage, NY

Systems integration and energy storage systems

Paper Battery Co. – Albany, NY

RPI spinout company developing paper battery system

Shreefal Mehta, CEO

Phone: (518) 331-0878 - Email: shreefal@paperbatteryco.com

Plug Power – Latham, New York (fuel cells)

Dan Bruck, Supply Chain Manager

Phone: (518) 738-0265 - Email: dan_bruck@plugpower.com

Precision Design Systems – Rochester, New York

Manufacturing, Engineering and Systems Integration Company in waste to energy solutions, optimal energy consumption systems and fuel cell test systems

Bill West, President

Phone: (585) 426-4500 - Email: WWest@precisiondesigns.com

Website: <http://www.precisiondesigns.com/index.php>

Primet Precision Materials – Ithaca, NY

Creating, controlling and characterizing particles and materials at the micron and nano scale

Lawrence Thomas, CEO

Phone: (607) 277-0700

Website: <http://www.primetprecision.com>

Raymond Corp. – Greene, NY

Manufacturer of electric lift trucks

Paul McCabe

Phone: (607) 656-2311 - Email: pmccabe@raymondcorp.com

Website: <http://www.raymondcorp.com/>

Shokai Far East Ltd. - Cortland Manor, NY

Manufactures custom electronic assemblies & devices including battery holders and rechargeable battery packs

Phone: (914) 736-3500

Website: <http://shokaifareastt.com/products/battery>

SR Batteries - Bellport, NY

Design and manufacturing of custom industrial, military and commercial battery packs

Phone: (631) 286.0079

Website: <http://srbatteries.com>

Superpower – Schenectady, NY

Development of commercially feasible second-generation (2G) high temperature superconductors (HTS) and related subsystems; subsidiary of Royal Philips Electronics N.V.

Arthur P. Kazanjian - General Manager and Finance Director

Phone: (518) 346-1414

Website: www.superpower-inc.com/

Ultralife Corporation - Newark, New York

Began as a battery company and now offers products and services ranging from portable and standby lithium ion power solutions to communications and electronics systems

Ralph D. Wise, Director of Technology

Phone: (315) 359-6607 - Email: rwise@ulbi.com

Website: <http://www.ultralifebatteries.com/index.php>

Additional contact

Contact: Adeeb Saba, Director of Technology

Phone: (315) 332-7100 , x679 - Email: asaba@ulbi.com

Summary of Updates:

3/16/09 version: additional companies added in Appendix 1

5/26/09 version: added Polytechnic Institute of NYU; added Dayton T. Brown to Appendix 1