See table of contents, p. ii

Holiday Greeting from the Director

Dear Members and Friends of IPST,

As we bring the calendar year to a close, I am reflecting on a productive period in the life of IPST, and how much we appreciate your continued engagement and support.

The IPST community joins in congratulating and celebrating Professor Art Ragauskas, to whom TAPPI has just awarded the 2014 Gunnar Nicholson Gold Medal award *(see related article).* This is the US forest products industry's highest scientific recognition. The many articles in this newsletter featuring Art's most recent contributions and activities are further evidence of his dedication and service to our industry. Doug Dugal, who served on the IPST staff for many years, was awarded this year's Herman Joachim Distinguished Service award. Both awards will be presented at TAPPI's annual meeting this spring.

This year's Wallenberg prize was awarded to Professor Derek Grey of McGill University, Montreal, for his pioneering research on nanocrystalline cellulose, creating vast potential for advanced forest products and significant new markets. Art Ragauskas and I represented IPST at the award ceremonies, which included a reception at the consulate of the Canadian Ambassador to Stockholm. It is striking to see these demonstrations of the significance these two countries attach to forest products research.

We were gratified and energized by the results of the Tenth-Year Review culminating in a positive report to the Institute of Paper Chemistry Foundation (IPCF). The review occurred as a condition of the 2003 full merger of IPST with Georgia Tech. The review report, and its subsequent endorsement by the Foundation board, provided confirmation of company support for our business model, strategy and execution on behalf of the industry, as well as of the value of our alliance with Georgia Tech. We gained valuable input as to how to continue our progress and we will act on the recommendations.

This year we have accelerated work on an innovative professional master's degree in manufacturing leadership, with a concentration in forest bioproducts. This is a unique online engineering degree program designed to prepare promising engineers for advancement in manufacturing leadership and management positions. With Georgia Tech Professional Education, we are designing a program that can be implemented with a number of elective industry concentrations across the Tech campus.

Responding to industry's twin drives to improve existing manufacturing profitability while creating new revenue opportunities, IPST has launched five consortium initiatives aligned with the priorities recently highlighted by the industry's Agenda 2020 Technology Alliance. We are fine-tuning them with company input, and companies are subscribing to those initiatives (*see related article).*

Several faculty members and I have made visits to company locations to compare notes about strategy and direction. We have welcomed many company executives to campus for individual company activities and for our January Futures Workshop and April spring conference. The 2013 Spring Conference also commemorated IPST's twenty years in the Paper Tricentennial Building.

We have graduated 9 Paper Science and Engineering students during 2013. We celebrate their success and wish them well as they pursue challenging careers well equipped with knowledge of the potential for lignocellulosic materials in today and tomorrow's world.

You will find more about all of these items and many more elsewhere in this newsletter.

On behalf of the faculty and staff, I wish you a happy holiday season and a safe, healthy, and prosperous 2014.

Warm regards,

Norman

Table of Contents

Recognition

Tenth-Year Review of IPST Progress Affirms Strategy, Direction

The Institute of Paper Chemistry Foundation (IPCF) Board met October 22 and accepted its review team's report of IPST and Georgia Tech's implementation of the 2003 agreements that formally merged IPST with Georgia Tech. The Board "concluded, without reservation, that IPST is performing satisfactorily in the industry environment in which it is working." IPCF president George Lanier further stated in a letter to IPST director Norman Marsolan that the board is "especially appreciative of the significant improvements that have been implemented since the five-year review and salute the many positive efforts across the Georgia Tech community that have made them possible."

Responding to the Board's action, Marsolan commented, "IPST is succeeding and, in partnership with the industry, has the opportunity to contribute to the industry's success. We are pleased that the review team's report and the Board's acceptance of it affirm the industry's support for our strategy and direction."

The report and Board action recommended further actions to deepen industry engagement and increase its research investment at Georgia Tech. "The report also reminds us of the critical importance of increasing our engagement with the industry and growing research investment here on the Georgia Tech campus," Marsolan continued. "We have an important opportunity to partner with the forest bioproducts industry and our colleagues across this campus to accomplish this, while preparing top-tier students for leadership positions in the industry."

Former IPST president Jim Ferris oversaw the review effort for the Foundation Board. Last April, the Board commissioned John Hanby to lead the review team. Hanby is an alumnus of both Georgia Tech and IPST and was formerly a research and technology leader with several paper and forest products companies. Other members of the team included Dean Benjamin, Director of Research for NewPage; Beth Cormier, Vice President of Research and Innovation for Sappi Fine Paper; Dan Floyd, Operations Director for Renmatix; Gopal Goyal, chief technology scientist for International Paper Company; Phil Jones, Director of New Ventures and Disruptive Technologies for Imerys; and Bruno Marcoccia, Director of Research and Development for Domtar. Ron Rousseau, Georgia Tech Professor and past Chair of the School of Chemical and Bimolecular Engineering and former IPST director also participated on the review team.

IPST and Paper Tricentennial Building a Popular Venue for Networking and Social Gatherings

GT Provost Rafael Bras hosted a reception in May, 2013 at the Robert C. Williams Papermaking Museum in the Paper Tricentennial Building to introduce key leaders from across the campus to his new Arts at Tech initiative.

GT EVP-Research Steve Cross held his holiday party November 22. The event heightened the exposure of the Robert C. Williams Museum of Papermaking to Georgia Tech's research program leadership.

Continued on next page - **Venue**

Venue

Continued from last page

IPST Director Norman Marsolan hosted a holiday celebration for Paper Science and Engineering faculty and students December 2 in the building's dining room.

IPST Activities

Continued Progress in Proposed Professional Master's Degree in Manufacturing Leadership

Progress continues in IPST's collaboration with Georgia Tech Professional Education to develop an online professional master's degree in manufacturing leadership. This is a unique degree program designed to prepare promising engineers with 3-5 years' experience for advancement in manufacturing leadership and management positions. The four-quadrant program combines advanced technical education in an elective manufacturing field with three core components in business and finance, manufacturing excellence, and leadership—four areas critical to the rising professional in the manufacturing environment.

Recent marketing studies suggest that there is enthusiastic demand among company manufacturing executives for candidates with such preparation. Because the program would mostly be conveyed in an online format, students would be able to continue their employment while enrolled. This design is intended to facilitate students' bringing their real-world experience to the program, and gaining insights and approaches to challenges they are facing in their jobs. As one young engineer surveyed put it, "This would be so much more useful to me than a traditional MBA, because it's designed around manufacturing."

The degree development team, led by GTPE director Leo Mark and IPST director Norman Marsolan, expects to have a proposal to the Georgia Board of Regents in 2014.

KapStone Joins IPST

IPST is pleased to welcome its newest member, KapStone Paper and Packaging Corporation. KapStone, formed in April 2005 and headquartered in Northbrook, Illinois employs 4,500 people. KapStone is a leading North American producer of unbleached Kraft paper and corrugated products. The Company is the parent company of KapStone Kraft Paper Corporation and KapStone Container Corporation. KapStone's mills produce Kraft and recycled products including liner and medium containerboard, Kraft papers, saturating Kraft, and folding carton board. Branded products include Kraftpak.®, DuraSorb® , TEA-Kraft® and FibreShield®. KapStone's corrugated packaging business produces fully equipped corrugated box plants, sheet plants, and sheet feeders providing industrial and retail corrugated packaging solutions for diverse customers.

Associations

IPST Welcomes Agenda 2020 to the Paper Tricentennial Building

As an affiliate member of the forest products industry's Agenda 2020 Technology Alliance, IPST supports the research organization through participation, collaboration, and occasionally hospitality. IPST hosted Agenda 2020's meetings at the Paper Tricentennial Building in September.

"We value our collaboration with Agenda 2020 for many reasons," commented IPST director Norman Marsolan. "Apart from collaborative research efforts, our affiliation not only provides our members and faculty opportunities to stay up to date on industry research priorities, but provides additional occasions for networking with Federal agencies and the national labs."

Continued on next page – **Agenda 2020**

Agenda 2020

Continued from last page

The central event was Agenda 2020's quarterly meeting, at which about two dozen company representatives, research scientists, faculty from Georgia Tech and other universities, and government officials attended. There was also a full-day workshop on black liquor concentration and a team meeting of the Advanced Pulping task force, as well as an Agenda 2020 Board meeting.

Fritz Paulsen and Greg Burns of Kapstone at an Agenda 2020 team meeting

IPST alumnus Chris Verrill of IP co-leads Agenda 2020's black liquor project team.

It was a good way to inaugurate the improvements to IPST's seminar room, which has been outfitted with an integrated sound system to accommodate effective remote participation.

[Please see related article on IPST's research initiatives in industry research priorities below.]

TAPPI IRMC Meeting in Montreal

IPST Director Norman Marsolan attended the November 5-7 meeting of TAPPI's International Research Management Committee in Montreal. The IRMC is comprised of industry chief technology officers and academic leaders important to research and development in the pulp, paper, and packaging industry.

This year's program focused on issues facing the industry in Canada and included a tour of the Industrial Materials Institute National Research Council Canada in Boucherville.

The conference program is at https://www.etouches.com/ehome/68411/138174/

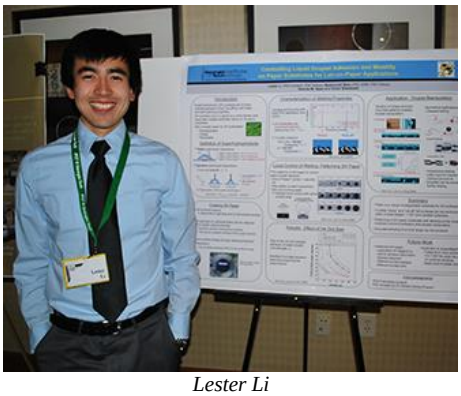
TAPPI Journal Issue on Bleaching

The October 2013 issue of the TAPPI Journal was dedicated to bleaching economics and bleaching technology. Topics included the use of models to optimize cost and performance, bleaching optimization, hemicellulose extraction, and brightening agents. Art Ragauskas of IPST, Magnus Paulsson of Akzo Nobel, and Gopal Goyal of International Paper worked together to solicit articles and edit the issue.

In addition to articles authored by Ragauskas, Paulsson, and Goyal, Peter Hart and Ricardo Santos of MeadWestvaco wrote articles for the issue.

Alumni

Lester Li Receives PhD; Heads to SAPPI



Lester Li

Lester Li earned his PhD in Chemical and Biomolecular Engineering/Paper Science and Engineering last summer. His research has focused on Superamphiphobicity, a combination of superhydrophobicity (high water repellency) and superoleophobicity (high oil repellency). Li's research on superamphiphobic paper surfaces has received some notable recognition already—during his time at IPST, Lester has presented at several TAPPI and IPST conferences, and his work has been mentioned in the Wall Street Journal.

Along with his advisors, Dr. Victor Breedveld and Dr. Dennis Hess, Lester's research is aimed at modifying the wetting properties—by both water and oil—of paper through the use of plasma processes so that the paper can repel liquids without the use of plastic or wax coatings. These superamphiphobic paper surfaces have many potential applications including packaging technology and biomedicine. These surfaces are of substantial interest due to their ability to control fluid-surface interactions**.** Development of superamphiphobic surfaces for paper is also attractive from an economic standpoint because paper is biodegradable, inexpensive, and is available worldwide.

The ability of paper to repel water or oil is related to the surface structure and chemistry of the paper. Paper, composed of cellulose fibers, has inherent roughness on the micron length scale making it an appropriate substrate for investigation. Superhydrophobic surfaces have been achieved on a wide variety of substrates using many different processes, but superoleophobicity is more difficult due to the lower surface tension of non-polar liquids and the more stringent requirements on surface properties. The oleophobicity of a surface is strongly reliant on the spacing between the surface structures—in this case, the fibers.

Through the use of plasma etching and deposition, Li and his advisors generated the first reported paper surfaces that are both superhydrophobic and superoleophobic. The refining process used by Li created smaller diameter fibers that are more closely packed together, resulting in a substrate more amenable to superamphiphobic and superoleophobic properties.

Dr. Breedveld says Lester Li was "an extremely creative and good student. He was driven and organized and had new, good ideas for research. He left our team as a confident, independent researcher."

Lester now works for SAPPI at its Westbrook, Maine North America Technology Center Research and Development facility.

Lester has also won awards in graduate school including a George W. Mead Award for his entry in the GTRIC poster competition. Lester was selected based on the fact that his work represented innovation in forest bioproducts research. Lester joined the PSE program in 2009 after receiving his undergraduate education at Worcester Polytechnic Institute, earning a BS in Chemical Engineering.

Continued on next page - **Li**

Li

Continued from last page

Posters and presentations of Li's work can be found at:

http://www.tappi.org/Downloads/Conference-Papers/2013/13PaperCon/13PAP143.aspx

http://www.ipst.gatech.edu/meeting/2012/2012_posters/li_lester.pdf

http://www.ipst.gatech.edu/meeting/2012/2012_presentations/19-Lester%20Li-Superhydrophobicity%20and%20Oleophobicity%20on%20Paper%20Using%20Plasma%20Treatments.pdf

http://www.ipst.gatech.edu/meeting/2012/2012_posters/li_lester.pdf

The Wall Street Journal article can be found at:

http://online.wsj.com/news/articles/SB10001424127887324412604578515310574797872

IPST Receives Bequest from Alumnus William McPherson

William McPherson

IPST has received a generous bequest from the estate of William H. McPherson. Dr. McPherson received his PhD in chemistry in 1948 and his MS in 1946 from IPC when it was located in Appleton, Wisconsin. He had a long career in research with the Minnesota-Ontario Paper Company in International Falls. Dr. McPherson passed away in December 2012.

Funds from the bequest went to the IPST Alumni Association Scholarship Endowment to benefit graduate students in paper science and engineering.

Former Faculty Member Celebrates 95th Birthday

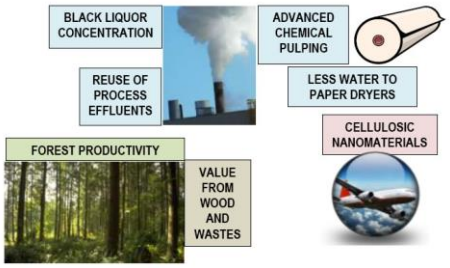
William Shockley Jr. was an IPC faculty member in the 1940s when it was located in Appleton, Wisconsin. Mr. Shockley earned a BS in Chemistry from Northwestern University and worked at IPC for several years. His daughter Kris Bakula reports that he went on to enjoy a long career in the paper and clay industry working for Georgia Kaolin and Nord Kaolin. Congratulations to our former colleague and friend.

William Shockley Jr.

Research

IPST Consortium Research Opportunities Support Agenda 2020 Research Priorities

In October, IPST director Norman Marsolan, in collaboration with Georgia Tech/IPST faculty, announced consortium project initiatives in five areas important to IPST member companies. The principal investigators for each project conducted information sessions throughout October, and member companies are now subscribing to the projects. The projects could launch early in 2014.



Agenda 2020's Priority Research Areas

The project areas chosen stem from the industry's priorities as discerned by Agenda 2020's Board of Directors. In April 2013, the Agenda 2020 board refocused the organization's research priorities into five priority areas, as shown in the graphic. The technology alliance has organized teams to tackle each priority by reviewing what is known, identifying research gaps and potential ways to address them, and establishing circles of expertise. IPST hosted team meeting of two of those teams during September in conjunction with Agenda 2020's quarterly meeting *(see related article).*

Each IPST consortium research proposal addresses one of the five priorities. The project titles and research leaders are:

IPST Consortium Research Projects, FY 2014		
Priority Area	**Principal Investigator**	**Project Title**
Advanced Pulping	A. Ragauskas	Wood Chip Activation For Next-Generation Kraft Pulping/ Bleaching Technology
Black Liquor Concentration	S. Nair	Robust Membranes For Concentration Of Black Liquor
Drier Web	D. Rosen	Novel Press Fabric Design And Manufacture To Improve Dewatering
Reuse of Process Effluents	P. Singh	Corrosion Control In Paper Machines Using Reduced Fresh Water
Cellulosic Nanomaterials	Y. Deng A. Ragauskas	Green Packaging With Cellulose Nanomaterials

Companies interested in participating—regardless of membership status—should contact Norman Marsolan (norman.marsolan@ipst.gatech.edu) as soon as possible.

Nanocellulosic Research Meeting Held at ORNL

Researchers reported significant progress October 29-30 at Oak Ridge National Laboratory during a second-annual review of consortium research on nanocellulosic materials. The consortium, organized in 2011 with US Forest Service funding, is a collaboration of the Forest Service, the Agenda 2020 Technology Alliance, and universities. Since 2004, the Forest Service-Forest Products Laboratory (FPL) and the Agenda 2020 Technology Alliance have been working collaboratively with university and other key partners to advance the commercial production and use of nanocellulosic materials from wood-based materials.

Nanocellulosic materials have the potential to become the basis of renewable, recyclable, sustainable materials in a host of applications including films, coatings, packaging, sensors and biosensors, communications, energy generation & storage, flexible electronics, batteries, automotive and aerospace, composite building materials, and much more.

Examples of the types of research and activities reported at the Oak Ridge session included:

- Development of advanced techniques using light and infrared chemical imaging to examine behavior of the materials at the nanoscale that could lead to highly sophisticated separation and material construction techniques.
- Incorporation of nanocellulose in various types of composites to improve fiber-polymer interactions--such insights will facilitate development of commercial applications.
- There are potential applications such as barrier packaging, various types of composites, aerogel insulation, shock absorbers, photovoltaics, and additive manufacturing.
- FPL and the University of Maine-Orono reported growing experience in manufacturing optimization at their small-scale nanocellulose pre-prototype production facilities. They also noted increasing shipments of test materials, suggesting growing interest in the U.S. and abroad.

In addition to IPST and Georgia Tech, researchers from North Carolina State University, Oregon State University, The Pennsylvania State University, Purdue University, and University of Maine reported on their work. Also, ORNL staff provided an in-depth tour of the Spallation Neutron Source, the Center for Nanophase Materials, the High Temperature Materials laboratory, and the BioEnergy Science Center, generating more ideas for nanocellulose research opportunities.

More than 50 industry representatives, university researchers, and government scientists attended including representatives from ORNL's Advanced Manufacturing and BioEnergy programs. Georgia Tech was represented by Norman Marsolan, Art Ragauskas, Robert Moon, Natalie Girouard, Carson Meredith, Meisha Shofner, Bernard Kippelen and Yulin Deng.

Georgia Tech was awarded three grants in connection with this program. One went to Dr. Bernard Kippelen to support his work in nanocellulose for flexible electronics, one to Drs. Carson Meredith and Meisha Shofner to study cellulose nanocrystal-based aerospace electronics, and one to Drs. Yulin Deng and Art Ragauskas for improved barrier packaging.

IPST Welcomes USFS' Robert Moon

Robert Moon

Dr. Robert Moon, a USFS Materials Research Engineer, joined Georgia Tech in September on assignment to further advance technology development in cellulose nanomaterials (CNs). Dr. Moon will be housed in IPST's Paper Tricentennial Building. This assignment, following a six-year similar arrangement at Purdue University, reflects the importance that the USFS places on the potential of nanocellulose technology to further the USFS' goal to fully utilize its renewable resources. The United States Forest Service-Forest Products Laboratory (FPL) has a long history of collaboration with the paper industry to develop innovative new science and technologies related to wood utilization, nanotechnology, and cellulose-based composites.

Dr. Moon says that IPST is a logical next stop for the USFS to expand its work in cellulose nanomaterials. He successfully built a cellulose nanomaterials program at Purdue University, and now is an opportune time to explore new capabilities and interest in renewable materials. "Georgia Tech is the place to go for its atmosphere of highly driven and exceptional students, scientists and faculty, combined with Georgia Tech's unique infrastructure comprised of specialized research centers and institutes," he observes. Of particular importance is the need to have paper and cellulose experts close at hand, with an intimate knowledge of lignocellulosic materials and their chemistry. He hopes to be a "boots-on-the-ground" resource and encourage research across multiple disciplines to advance science in cellulose nanomaterials leading to the creation of new and improved products.

In addition to IPST, Dr. Moon will also work closely with other centers and institutes at Georgia Tech and with other universities and institutions within the region. Though his primary focus will be on cellulose nanomaterials, Dr. Moon will also explore the nanotechnology aspects of other tree components including lignin and hemicellulose.

Cellulose nanomaterials have some additional advantages. The small size results in diminished light scattering (as compared to pulp fibers) allowing for the processing of transparent papers and composites. Preliminary studies have indicated low environmental, health, and safety risks of cellulose nanomaterials. Additionally, cellulose nanomaterials are inherently renewable, sustainable, biodegradable, and carbon-neutral, like the sources from which they are extracted, and they have the potential to be processed at industrial scale quantities and at low cost. Similar to paper, cellulose nanomaterials are an opportunity for the production of environmentally friendly composite structures at quantities large enough to address societal needs. Cellulose nanomaterials further extend the utility of cellulose-based materials into an ever-widening range of consumer products from new packaging/barrier applications to electronics (e.g. flexible circuits), energy (e.g. flexible solar panels), and defense (e.g. body armor, transparent armor).

Cellulose nanomaterials have some additional advantages. The small size results in diminished light scattering (as compared to pulp fibers) allowing for the processing of transparent papers and composites.

Continued on next page - **Moon**

Moon

Continued from last page

Preliminary studies have indicated low environmental, health, and safety risks of cellulose nanomaterials. Additionally, cellulose nanomaterials are inherently renewable, sustainable, biodegradable, and carbon-neutral, like the sources from which they are extracted, and they have the potential to be processed at industrial scale quantities and at low cost. Similar to paper, cellulose nanomaterials are an opportunity for the production of environmentally friendly composite structures at quantities large enough to address societal needs. Cellulose nanomaterials further extend the utility of cellulose-based materials into an ever-widening range of consumer products from new packaging/barrier applications to electronics (*e.g.*, flexible circuits), energy (*e.g.*, flexible solar panels), and defense (*e.g.*, body armor, transparent armor).

Dr. Moon received his PhD in Materials Engineering and his MS in Metallurgical Engineering at Purdue University. He received his BS in Metallurgical Engineering from the University of Wisconsin at Madison.

IPST Joins ORNL Carbon Fiber Composites Consortium

Georgia Tech is now a member of the Oak Ridge Carbon Fiber Composites Consortium. The group is a "consortium of private industry, government agencies, and educational institutions that share interest in sharing information on carbon fiber technologies and in developing relations which will foster future collaborations." Established in 2011 to accelerate the development and use of new, lower cost carbon fiber composite materials, the Consortium draws on the expertise of Oak Ridge National Laboratory and its more than 45 members. The Consortium also supports the US Department of Energy's investment in the Carbon Fiber Technology Facility.

Dr. Ragauskas' Group Installs New M/K Digester

The latest addition to Dr. Ragauskas' laboratory is a modified kraft (M/K) digester, which is capable of simulating almost any modified Kraft cooking process. The digester system permits sampling and adjustment of pulping liquors while cooking is in progress. This capability, coupled with computer-assisted procedures for rapid liquor analysis and adjustment, allows the M/K digester system to simulate a variety of biorefining pretreatment protocols and modern cooking technologies used in Kraft pulp mills.

Digester features include a pair of 10-liter circulated vessels with a liquor injector, a rapid circulating and mixing system, and precise temperature and pressure controls. The dual vessel system enables the user to generate steam or to preheat liquor in one vessel for use in cooking in the other vessel. A temperature sensor capable of measuring to a one-tenth of a degree Celsius accuracy is located directly in the flow stream of liquor for optimum temperature sensing.

Faculty in the News

Getting to Know Nicholson Gold Medalist Professor Art Ragauskas

TAPPI recently announced that it has awarded the 2014 Gunnar Nicholson Gold Medal to Professor Art Ragauskas. The award will be presented at the annual meeting this spring.

The TAPPI Gunnar Nicholson Gold Medal Award is the highest honor that the Association can bestow upon an individual. Established in 1928, the Gold Medal is granted to those "who have made preeminent scientific and engineering achievements of proven applied benefit to the world's pulp, paper, board, and forest product industries. The forest product industries include forestry, derived products, their process technology, and their applications."

Art Ragauskas

Dr. Art Ragauskas has spent his career immersed in two passions—wood chemistry and green chemistry.

Dr. Ragauskas' group focuses on the green chemistry of biopolymers including cellulose, hemicellulose, and lignin. Through the use of green chemistry, biotechnology, and cold plasma, his research looks at new ways to synthesize novel biomaterials, biocomposites, and biofuels from nature's renewable biopolymers. A particularly exciting aspect of this research is the development of new nano-cellulose-based and hemicellulose-based materials. Such innovative research approaches may allow researchers to synthesize new biomaterials for applications in health care, security, and packaging. An important piece of the Ragauskas group's work is the

Continued on next page - **Ragauskas**

study of lignin and pseudo-lignin chemistry. Understanding this complex chemistry will advance the use of cellulose-based materials in biofuels.

On his web site, Dr. Ragauskas posts his three goals for his research and for his mentoring of students:

- Develop a challenging and enriching undergraduate educational and research experience that facilitates intellectual development of the students and supports the mission of the School of Chemistry and Biochemistry
- Recruit, educate, and develop the next generation of scientists that will be nationally/internationally recognized leaders in green chemistry of biomaterials, biochemicals, biopower, biofuels and biological systems
- Develop a nationally/internationally recognized research center for sustainable green chemistry of biopolymers and their conversion to innovative biomaterials, biochemicals, biopower, biofuels and biological systems

Professor Ragauskas says "IPST and Georgia Tech is a wonderful environment to find and to develop young scientists. I have fine physical facilities and worthy colleagues here."

Currently, 8 students are studying under Dr. Ragauskas including Fan Hu who will receive his PhD next spring. Currently, Dr. Ragauskas manages a research group of 25 graduate students, postdoctoral research fellows, a research scientist, and visiting scientists.

Prior to being awarded the Nicholson Gold Medal, Professor Ragauskas had previously been recognized nationally and internationally as a leader in both in the paper industry and in alternative energy applications. He held the first Fulbright Chair in Alternative Energy and is a Fellow of the American Association for the Advancement of Science, the International Academy of Wood Science, and TAPPI. His research has been sponsored by NSF, USDA, DOE, the Georgia Traditional Industry Program, and several fellowship programs. His Fulbright-sponsored activities at the Chalmers University of Technology, Sweden were focused on the forest biorefinery and new biofuel conversion technologies for lignocellulosics. He was also nominated to the National Commission on Energy Policy and has won many prizes and awards from national and international organizations.

Ragauskas has served on several advisory boards and review panels in North America including the J. Paul Getty Trust, National Science Foundation, USDA, USDOE, Advanced Research Projects Agency-Energy Natural Sciences and Engineering Research Council of Canada, Biofuel Advanced Research and Development**,** TAPPI Research Management Committee, and in numerous countries including Austria, China, France, Finland, the Netherlands, Norway, Portugal, Singapore, Sweden, and Switzerland.

After receiving his PhD from the University of Western Ontario, Professor Ragauskas accepted two postdoctoral fellowships, first at the University of Alberta and then at Colorado State University. After two years as a research scientist at the National Research Council of Canada, Dr. Ragauskas joined IPST in 1989. Since then, he has advanced the academic ladder becoming a Professor in the Georgia Tech School of Chemistry and Biochemistry in 2007.

Continued on next page – **Ragauskas**

Ragauskas
Continued from last page

For a complete curriculum vitae, see http://www.ipst.gatech.edu/faculty/ragauskas_art/art_cv.pdf

For more information on research by the Ragauskas group, see http://www.ipst.gatech.edu/faculty/ragauskas_art/ragauskas_research_studies.html

Professor Ragauskas Receives Oak Ridge National Laboratory Fellowship and ACS Recognition

For the last decade, the work of Dr. Art Ragauskas' group has focused on the forest biorefinery. Given the nature of the challenges and opportunities, Dr. Ragauskas seeks to partner with a variety of people and organizations to help fast track these technologies. As part of this mission, Dr. Ragauskas accepted a unique opportunity to work with Oak Ridge National Laboratory (ORNL) as a Visiting ORNL Fellow on the utilization of lignin for carbon fibers and related materials derived from next generation biofuel biorefineries. This opportunity leverages Dr. Ragauskas' group's expertise in lignin chemistry and ORNL's expertise in transgenic plants, biorefining, and renewable energy security.

Dr. Ragauskas' work has been noted by the American Chemical Society. He has been honored with the American Chemical Society's award for Affordable Green Chemistry. Along with other ACS award recipients, Dr. Ragauskas will be honored at the 247th Annual ACS meeting in March 2014. The ACS has issued a call for papers for a symposium to honor Dr. Ragauskas. The symposium will feature topics in green chemistry research including biomass characterization, lignocellulosic recalcitrance, biological deconstruction and biofuels, biomass pretreatments, and green biorefining biomass. The annual meeting will be held in Dallas.

The Affordable Green Chemistry award is sponsored by Dow Chemical and endowed by Rohm and Haas. Dr. Ragauskas credits this award not only to his work but to the efforts of his graduate and postdoctoral students, and to his researchers, research partners, and the support staff at IPST.

Also, the American Chemical Society recognized research conducted by Dr. Ragauskas and IPST alumnus Haoxi Ben (PhD Chemistry/Paper Science and Engineering) as noteworthy chemistry.

In this research, Drs. Ragauskas and Ben used zeolite additives in the pyrolysis of lignin to produce simple aliphatic and aromatic liquids more suitable for possible fuel use. They used a one-step thermal

Continued on next page – **Oak Ridge**

Continued from last page

conversion of lignin to gasoline-range liquid products; the ratio of heavy to light oils and the degree of formation of polyaromatics depended on the zeolite structure. The zeolite additives promoted dehydration and decarboxylation and were more effective than a control pyrolysis oil generated without a zeolite additive.

Dr. Ben is pursuing post-doctoral studies at USDOE's National Renewable Energy Laboratory in Golden, Colorado.

The research was published in *RSC Advances* 2012, *2(33)*, 12892 – 12898.

Professor Dennis Hess Receives Honors from American Chemical and Electrochemical Societies

Dennis Hess

In September, Dr. Dennis Hess, Professor and Thomas C. DeLoach, Jr. Chair in the School of Chemical & Biomolecular Engineering was selected as a member of the 2013 class of Fellows of the American Chemical Society (ACS). The ACS Fellows Program honors ACS members who have made significant contributions to the sciences and the profession, and who have provided excellent service to the ACS community. Members retain the designation as an ACS Fellow, ACSF, for life. Hess, along with the other 2013 ACS Fellows, was honored at a ceremony during the ACS National Meeting in Indianapolis on September 9. Professor Hess will also receive the Henry B. Linford Award for Distinguished Teaching from the Electrochemical Society (ECS). The Linford award recognizes excellence in teaching in subject areas of interest to the ECS. The award will be presented at the Society's May 2014 meeting.

Dennis has been increasingly engaged with IPST and the forest bioproducts industry in recent years through his investigations of thin film and coating processes as related to the surface modification of cellulosic materials. Fundamental chemical and physical properties of the films are explored in order to devise unique film materials and processing sequences relevant to value-added products including paper and paperboard. His research has included paper coatings which are superhydrophobic, hydrophobic, oleophobic, and superoleophobic.

"The Linford recognition means a great deal to me because it acknowledges both my academic career and my involvement in educational and professional development activities within The Electrochemical Society," Hess says. "Similarly, I have highly valued the networking and journal editorial opportunities I have experienced over the years within the American Chemical Society."

Dr. Preet Singh's Corrosion Laboratory Upgraded and Ready to Help

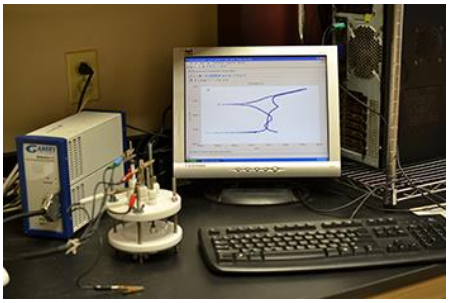
Preet Singh

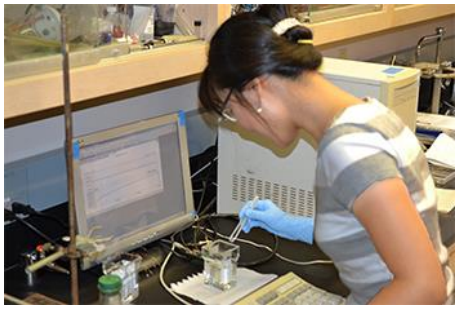
Professor Preet Singh has spent his professional career working to understand environmental degradation of metallic materials and to ensure the reliable and long-term performance of these materials in corrosive environments. Professor Singh's work was recognized by his election this year as a Fellow in the American Society of Metals International. His citation reads, "For significant contributions in the scientific and engineering aspects of materials reliability and stress corrosion cracking by developing a mechanistic understanding of complex phenomena." Dr. Singh received the award at the ASM Awards Dinner in Montreal in October.

Reliable performance of the equipment is critical to the papermaking process because of the need to ensure a quality product and to overcome the challenges of the capital-intensive nature of the business. As in any industry, selection of materials is based on the required mechanical properties, the cost, and the desire for minimal maintenance both in terms of manpower and cost.

Process changes can lead to higher corrosion susceptibility. Often, there is pressure to extend the life of existing equipment rather than replace it. Dr. Singh's work includes research into all aspects of corrosion science and engineering including stress corrosion cracking, corrosion fatigue, and high temperature oxidation.

In the paper industry, corrosion may occur in the hot and caustic environment of the pulping process, the oxidizing environment of bleach plants, the high temperature gaseous environment of recovery boilers, or the relatively benign environment in the paper machine.





Continued on next page - **Singh**

Singh

Continued from last page

Dr. Singh reminds us that corrosion and materials engineers are important to the selection, maintenance, and modification of material needs: "My group is here to help personnel in the industry evaluate which alloys to select for which process. In other words, will they work for the intended purpose? We are also here to evaluate what happens if a process is changed. Will that lead to degradation of equipment or a product problem?"

Analytical and characterization tools needed for corrosion research are available either in Dr. Singh's laboratory or in the School of Materials Science and Engineering. Software for thermochemical calculations is used for thermodynamic predictions and modeling of corrosion processes.

Dr. Singh's laboratory has undergone significant upgrades in equipment and functionality. In the last few years, the laboratory added new autoclaves, new furnaces, and new Slow Strain Rate Test rigs. In 2013, the laboratory layout was redesigned and new furniture acquired and installed. The redesign has allowed greater functionality and a better, more productive working environment for Dr. Singh and his team.

Prior to joining MSE in July 2003 Professor Singh had been a faculty member in the Corrosion and Materials Engineering Group at The Institute of Paper Science and Technology (IPST) since 1996. Dr. Singh has been working on fundamental as well as applied research projects related to the corrosion problems in the pulp and paper industry since 1996. From 1990 to 1996, he was a Senior Research Associate at Case Western Reserve University working on various materials and corrosion-related research projects. Dr. Singh has published over 175 papers, of which over 150 papers have been published in refereed journals, book chapters, and conference proceedings. He has given over 200 technical presentations, of which 55 were invited technical presentations and over 85 were contributed conference presentations. Dr. Singh is a Fellow of NACE International and Fellow of ASM International.

In 2012, two students received PhDs under Dr. Singh and two received MS degrees. His group now consists of three PhD students, one postdoctoral fellow, and one research engineer.

Meisha Shofner Explores Paper Structure and Its Opportunities

Meisha Shofner

Dr. Meisha Shofner's varied research at IPST-Georgia Tech explores paper's structure and seeks ways to take advantage of its properties as well as the properties of forest-based biomaterials to create new uses—uses that may lead to attractive commercial applications. These applications may also advance ecologically attractive goals such as biodegradability and compostability. Dr. Shofner joined Georgia Tech in 2005, and she has collaborative relationships with other IPST faculty.

A threshold component of Dr. Shofner's work is understanding the unique structure of paper. Paper is a highly engineered structure. This network feature leads to unusual properties, *e.g.*, having a negative Poisson's ratio or auxetic properties. Her research, in collaboration with Professor Anselm Griffin, seeks to reverse-engineer paper to better understand its structure. "Understanding the structure of paper can be an inspiration for understanding other networked structures," Shofner says.

Dr. Shofner's work in nanotechnology has received funding support and peer recognition. This research further advances the learnings about paper structure to process and characterize cellulose-based nanocomposites to understand the available structure-property design space. This fundamental understanding will provide insight into other types of polymer nanocomposites and provide guidance for nanofiber composite design.

Nanotechnology projects currently in progress include:

- Shofner's group explores cellulose nanocrystals as potential building blocks that can be used in water-based polymers. If successful, this research will lead to the development of new materials with the special attributes of paper and reduced environmental impact.
- Dr. Shofner's paper, "Crystallization of Cellulose Nanocrystal / Polyhydroxybutyrate Nanocomposites," presented at the 2012 TAPPI International Conference on Renewable Nanomaterials and co-authored by Stephanie Lin, describes studies focused on understanding how interactions of crystalline nanocellulose with polyhydroxybutyrate (PHB) can modify the crystal structure of PHB and toughen the matrix and, as a result, yield improved mechanical properties.
- Dr. Shofner's and Dr. Carson Meredith's work with cellulose nanocrystals was recognized by the USFS/Agenda 2020/University Collaboration with the award of a grant to study the incorporation of cellulose nanocrystals into matrices for high performance materials in the aerospace industry.
- Her research group, along with Dr. Eric Vogel's team, seeks to identify and create different cellulose-based substrates aimed at developing flexible and robust electronic devices. In particular, they are investigating the dry transfer of graphene—a two-dimensional monolayer of carbon atoms—on substrates. Graphene has high strength and offers much promise in electronic applications and paper is a promising substrate for graphene applications.

Continued on next page - **Shofner**

Shofner

Continued from last page

In addition to the nanotechnology research, Dr. Shofner has collaborated in investigations led by Dr. Sankar Nair in the School of Chemical and Biological Engineering to develop a robust membrane to concentrate black liquor by water removal. This has substantial energy savings potential but is challenging because the membrane must be able to survive in the harsh environment of black liquor.

Dr. Shofner received her BS in Mechanical Engineering from The University of Texas at Austin and her PhD in Materials Science from Rice University. After receiving her PhD, Dr. Shofner was a postdoctoral fellow at Rensselaer Polytechnic Institute. Prior to beginning graduate school, she was employed as a design engineer at FMC in the Subsea Engineering Division, working at two plant locations in Houston, Texas and the Republic of Singapore. Dr. Shofner is a registered Professional Engineer in Georgia. She was promoted to the rank of Associate Professor at Georgia Tech and awarded tenure effective July 1, 2013. Dr. Shofner currently supports 6 graduate students and one post-doctoral researcher.

Below is a link to papers and presentations by Dr. Shofner:
http://www.ipst.gatech.edu/meeting/2012/2012_presentations/15-Shofner%20-Cellulose%20Nanocrystal%20Polymer%20Composites%20Processing%20Strategies%20Impacts%20on%20Polymer%20Crystallization.pdf

Dr. Doug Dugal Wins Prestigious TAPPI Award

Dr. Hardev S. "Doug" Dugal, who served on the IPST staff for many years, was awarded this year's TAPPI Herman L. Joachim Distinguished Service Award. Established in 1983, the TAPPI Joachim Distinguished Service Award is the highest honor TAPPI can bestow upon an individual for exemplary leadership that has significantly contributed to the advancement of TAPPI. The award will be presented at TAPPI's annual meeting this spring.

Doug Dugal

Georgia Tech President Bud Peterson sent Dr. Dugal a message of congratulations, noting "This is well-deserved recognition of your many accomplishments and all you have done for the world's pulp, paper, board, and forest product industries and for Georgia Tech."

Dr. Dugal was also praised by Harry Spiegelberg, President of the Paper Industry Hall of Fame. He echoed President Peterson's remarks saying, "[I]ndeed, I among many people in the Fox River Valley are very proud of Doug's many contributions. Getting such a distinguished award from TAPPI is special for Doug and very well deserved."

Professor Deng Wins Andrew Chase Division Award

Professor Yulin Deng, from the School of Chemical & Biomolecular Engineering, received the Andrew Chase Division Award in Chemical Engineering from the AIChE Forest Bioproducts Division. The award recognizes an individual's outstanding chemical engineering contribution in the forest products and related industries.

Dr. Deng's selection was based on the following criteria: significant discoveries, research, or development, successfully implemented on a commercial scale; outstanding chemical engineering contribution(s) in the field of design, operation or production management which led to significant technological improvements; distinguished service as a chemical engineering educator, with an emphasis on application of chemical engineering principles to forest products industry technologies; and outstanding service to the division.

Yulin Deng

Dr. Deng was presented with the Chase award at the 2013 AIChE Annual Meeting in San Francisco.

Dr. Deng's group works in nanomaterial synthesis and self-assembling, biofuel and biomass materials, colloid and interface science and engineering, polymer synthesis, and papermaking and paper recycling. Dr. Deng is a Fellow of the International Academy of Wood Science, and a member of ACS, AIChE, and TAPPI. He earned his PhD at Manchester University.

Roman Popil Presents at TAPPI CorrExpo

IPST's Roman Popil presented a paper at the October 2013 TAPPI CorrExpo conference in Indianapolis. The presentation, titled "The BCT of Copy Paper Boxes - Applying McKee's Formula" is based on a specialty testing project for a major paper manufacturing client.

Roman Popil

The original "McKee equation" for predicting box compression strength was published by IPC in 1963 and has remained in use. Dr. Popil's talk showed how a popular simplified form of the equation can be applied to the special case of copy paper boxes by fitting the constants of the equation to experimental data obtained. The result is that the client is able to discriminate the stacking performance of copy paper boxes through a box compression test prediction based on some simple measurements.

At IPST, Dr. Popil manages the Paper Analysis Lab (PAL) focused on assisting industry customers with troubleshooting quality issues, product development or optimization through physical properties characterization. The PAL also develops new instrumentation and test methods.

Continued on next page - **Popil**

Popil

Continued from last page

Dr. Popil was the principal investigator for the Engineered Packaging and Products elective research consortium project. The project resulted in published articles on a predictive model for corrugated board performance, corrugated board shear, and compression strength measurement techniques, and the development and evaluation of wax replacement coatings for corrugated containers.

Dr. Popil earned his PhD in experimental plasma physics from the University of British Columbia. He has been granted three patents and authored or co-authored over 50 peer-reviewed publications.

The presentation and the accompanying article from the October TAPPI CorrExpo, can be found at: http://ipst.gatech.edu/faculty/popil_roman/newsletters/The%20BCT%20of%20Copy%20Paper%20Boxes.pdf

http://ipst.gatech.edu/faculty/popil_roman/newsletters/Box%20Compression%20for%20Copy%20Paper%20Boxes%20-%20Applying%20McKee's%20Formula%20%20-final.pdf

Dr. Sinquefield Offers Energy Research Using One-of-a-Kind Reactor

Scott Sinquefield

When Dr. Scott Sinquefield arrived at IPST in 1998, his first task was to oversee the acquisition and installation of a Pressurized Entrained Flow Reactor (PEFR) purchased from a Danish national research laboratory. Initially installed at IPST's Industrial Engineering Center on 14th Street, it was dismantled and moved again to Georgia Tech's new NIST-funded Carbon Neutral Energy Solutions (C-NES) Laboratory. The PEFR is designed to create a controlled environment of temperature, pressure, gas composition, and residence time, allowing fundamental and applied research in pyrolysis, gasification, and combustion of solid fuels. There are perhaps ten similar reactors world-wide, owned by universities or government research laboratories, and IPST's is by far the largest allowing long fuel particle residence times—on the order of 30 seconds. Initially the PEFR was used to study pyrolysis and gasification of black liquor (after being dried and ground into a powder). Years later its use was expanded into research on a variety of agricultural and forest biomasses, mill sludge, and coal. Since 2001, Dr. Sinquefield has been the principal investigator overseeing the PEFR, and a smaller atmospheric pressure Laminar Entrained Flow Reactor (LEFR). These reactors are ideally suited for taking reaction rate data to build kinetic models as well as other parametric studies. Considerable work was done to develop kinetic models for pressurized black liquor gasification. The PEFR was also used to study and develop titanate and borate direct causticizing chemistries to perform the causticizing process simultaneously during black liquor gasification. Current PEFR research includes fundamental studies of pyrolysis and gasification of loblolly pine, switchgrass, bagasse, corn stover, and lignite coal.

Continued on next page - **Sinquefield**

Sinquefield

Continued from last page

Dr. Sinquefield's other past and present research projects include:

- Development of a sulfur-tolerant CO_2 sorbent (patent pending) that works at gasifier temperatures. It is central to a process that allows high yields of hydrogen to be produced without the need for expensive water-gas-shift catalysts and for CO_2 to be captured for sequestration.
- Creation of a computer model for predicting precipitate (salt) species from concentrated non-ideal electrolyte solutions. The primary application was to predict black liquor evaporator scale composition.
- Design of a portable apparatus for evaluating commercial anti-scaling additives on site in the mill (United States Patent 6,978,663). The impetus was to test and benchmark additives used in black liquor heaters and evaporators, and do so in a matter of hours or days. Currently, such mill trials take several weeks to perform. The device can be used in any hot liquid process stream that is subject to scale formation related to heat transfer.

The IPST/ GA Tech Pressurized Entrained Flow Reactor in the high bay at C-NES.

Dr Sinquefield completed his PhD in Chemical Engineering in 1998 at Oregon State University. He spent three years working with the Multi-Fuel Combustion Group at the Combustion Research Facility at Sandia National Labs (Livermore) where he performed the experimental portion of his thesis research.

Georgia Tech Pulp and Paper Foundation Annual Meeting Held in November, Dr. Hsieh Honored

The Georgia Tech Pulp and Paper Foundation (GTPPF) held its annual meeting on campus on November 7, 2013. The GTPPF Board of Directors expressed appreciation to Professor Dr. Jeff Hsieh for his many years as a leader in the university community and in the industry. Dr. Hsieh has served as Director and Professor of the Georgia Tech Pulp and Paper Engineering Multidisciplinary Certificate Program for 30 years.

Dr. David Sholl, Chair of School of Chemical and Biomolecular Engineering, presented a plaque to Dr. Hsieh to commemorate his service. The plaque recognizes Dr. Hsieh "for his leadership, dedication, enthusiasm and outstanding distinguished service for the past 30 years." Board Chairman Harry Levengood observed, "Jeff has always worked tirelessly to promote the program to students and to the

Continued on next page - **Hsieh**

Hsieh

Continued from last page

pulp and paper industry. He is dedicated to teaching engineering students and to the advancement of the pulp and paper program at Georgia Tech."

"Teaching our pulp and paper students is more than just having their bodies and minds in the classroom," Dr. Hsieh commented. "The most important thing to help their learning about pulp manufacturing is to develop their interests and their passion and soul in the technology. The goal of our program is to provide students knowledge of the pulp and paper process, so that they might make an informed decision when pursuing careers within the paper industry and allied businesses."

David Sholl (left) presenting plaque to Jeff Hsieh

Students in the News

IPST Students attend AIChE Annual Meeting and TAPPI/PEERS Conference

IPST provided financial support to six students to attend the November American Institute of Chemical Engineers Annual Meeting in San Francisco. All six students presented papers (advisors shown in parentheses):

- Gautami Newalkar: "*Structure-Activity Relationships in Biomass Chars Formed in An Entrained-Flow Reactor*" (Dr. Pradeep Agrawal)
- Sarah McNew: *"Hydrogen-Deuterium Exchange Over Ceria-Zirconia Mixed Metal Oxides"* (Dr. Carsten Sievers)
- Jie Wu: *"Biorenewable Chitin Reinforced Polyethylene Oxide (PEO) Light Weight Composites"* (Dr. Carson Meredith)
- Sudhir Sharma: *"High Performance Green Barrier Films From Thermal Treatment of Cellulose Nanofibrils"* (Dr. Yulin Deng)
- Wei Mu: *"Mechanism Study of Noble Metal Catalyzed Upgrading of Lignin Derived Pyrolysis Oil*" (Dr. Yulin Deng)

Continued on next page - **AIChE**

AIChE

Continued from last page

- Xiaodan Zhang: *"Fabrication of Electronic Devices Using Highly Flexible Microfibrillated Cellulose"* (Dr. Yulin Deng)

Two students received financial assistance to attend and to present papers at the September TAPPI PEERS conference in Green Bay:

- Daniel Lee: *"Adsorption Deinking for Inkjet and Flexographic Ink"* (Dr. Jeff Hsieh)
- Tony Du: *"Quantitative Measurement of Microstickies by Model Surfaces"* (Dr. Jeff Hsieh)

The proceedings of the AIChE conference can be found at https://aiche.confex.com/aiche/2013/webprogram/ataglance.html

The 2013 TAPPI PEERS brochure is at http://www.tappipeers.org/pdf/brochure.pdf

Fan Hu Will Earn PhD in Chemistry

Fan Hu

Fan Hu will graduate in May 2014 with a PhD in Chemistry, with a minor in Paper Science and Engineering. Fan's research has focused on better understanding the chemistry of pseudo-lignin in an effort to advance cellulose-based biofuels.

Fan has conducted his research in Dr. Art Ragauskas' group. Lignin has long been recognized as a barrier to the use of woods, agricultural crops, and wastepaper as fuel supplements because lignin resists breakdown to fuel-attractive ethanol. Methods to reduce lignin, specifically the use of dilute acid pretreatment (DAP), result in the generation of a lignin-like material known as pseudo-lignin. Like lignin, pseudo-lignin is also a barrier to the availability of ethanol necessary for satisfactory biofuel use. His thesis work was aimed at characterizing pseudo-lignin extracted from pretreated biomass polysaccharides such as cellulose and hemicellulose; proposing possible mechanisms accounting for pseudo-lignin formation; and providing the reaction conditions to reduce pseudo-lignin formation without significantly lowering pretreatment severities. In addition, Fan revealed that the formation of pseudo-lignin spherical droplets on the surface of pretreated carbohydrates can occlude biomass pore structure and block enzyme accessibility or even non-productive bind to enzymes. Therefore, his research is important to understand and to optimize pretreatment conditions to increase the breakdown of cellulose by enzymes as well as reduce the carbohydrate degradation and inhibitor formation during pretreatment process.

Fan commented, "I enjoy my time at IPST very much. Not only I have gained world-class research knowledge and experience, but I have also have had the opportunity to make an impact on the industry."

Continued on next page - **Hu**

Hu

Continued from last page

After receiving his degree, Fan will seek a position in research and development in the biorefining industry. Fan began his studies at Georgia Tech in 2009. He received a BSc in Chemistry from the Hong Kong University of Science and Technology. Details on Fan's research can be found at:

http://bioenergycenter.org/besc/publications/hu_pseudo_lignin_yr5_final.pdf

http://ipst.gatech.edu/students/posters/2013/hu_fan.pdf

Wei Mu to Receive PhD in Chemical and Biomolecular Engineering

Wei Mu

Wei Mu, working under Dr. Yulin Deng, will receive his PhD in Chemical and Biomolecular Engineering. Wei's research has been on the degradation of biomass and its conversion to biofuel.

Wei is exploring other value-added opportunities for lignin, including the catalytic conversion of lignin into gasoline-compatible liquid fuel. Wei, who entered the doctoral program in Chemical and Biomolecular Engineering on an IPST Paper Science and Engineering Fellowship, is supervised by Professor Yulin Deng of IPST and the School of Chemical and Biomolecular Engineering. Wei plans to graduate with his PhD in December 2013.

Wei's research employs a two-step conversion of lignin into a liquid transportation fuel. The first step is pyrolysis, which decomposes lignin into smaller molecules. Step two is upgrading, which increases the hydrogen amount and partially removes oxygen. The upgrading step requires robust and active catalysts. His research focuses on the catalyst synthesis step and reaction kinetics modeling.

Wei received his MS in Paper Science and Chemical Engineering at Miami University (Ohio). He has industry experience with the Hercules Paper Division and Hercules Paper Technologies and Ventures in China, prior to earning his master's degree and coming to Georgia Tech for his PhD.

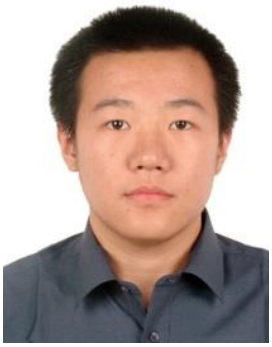
More detail on Wei's work and its recognition can be found at
http://ipst.gatech.edu/news/current/121221_mu.html

Zhenguan Tang Receives SAPPI Grant

Zhenguan Tang

Zhenguan Tang, studying under Dr. Victor Breedveld and Dr. Dennis Hess, received research funding from SAPPI Fine Paper. The project is aimed at fabricating unique barrier properties for paper-based substrates.

Yushu Wang Discusses Research at Atlanta ASM Meeting



Yushu Wang

IPST student Yushu Wang gave a talk at the September 17 meeting of the Atlanta chapter of the American Society for Metals (ASM). ASM is a professional organization for materials scientists and engineers working with metals.

Yushu's presentation was titled, "Pitting Behavior of Stainless Steels in Paper Machine White Water." Yushu is studying corrosion in paper machines under Dr. Preet Singh.

Tyrone Wells Reports from Sweden on His Research and His Adventures

Tyrone Wells, Gunnar Nicholson Fellow studying at the Chalmers Institute of Technology, has benefited from his research, and he is enjoying his cultural experience. His letter from Gothenberg gives an update on his research, credits his advisors, and reports on his extracurricular activities.

A Learning Experience at Chalmers

My year-long graduate student experience at Chalmers University of Technology in Gothenberg, Sweden has been the longest period of time that I have ever been outside of the United States. And now, roughly

six months into my stay, I finally feel like I have settled into the Scandinavian lifestyle--but I know there are still many opportunities for technical and personal growth.

Continued on next page - **Wells**

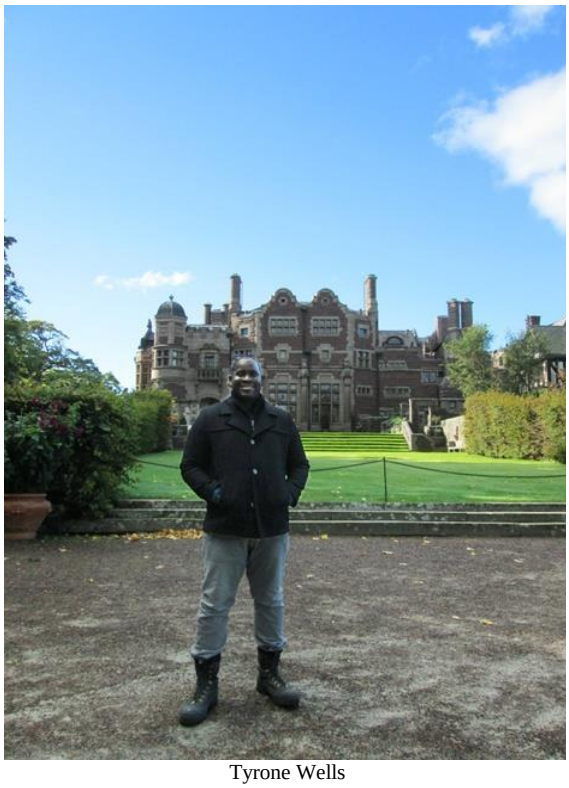
Wells

Continued from last page

My research at Chalmers involves finding new applications for lignin, which is a complex and currently underutilized plant-derived biomacromolecule. My work involves investigating a new way of turning this molecule into a more suitable precursor for carbon fiber production. The Chalmers research group that I am a part of has specialized in a highly effective lignin extraction process from industrial black liquor known as the Lignoboost™ process, and I'm using this type of lignin as part of my studies. I feel fortunate to be trained in this process by the founders of this technique. Likewise, I can also acknowledge the good fortune I have to work with such diverse and welcoming colleagues. I have found all our discussions and time spent together invaluable and working with people who reflect a broad range of cultures and outlooks has allowed me to improve as a person. The "home-field advantage" I've had when working in the US isn't a luxury I can take for granted anymore here, and it's interesting to recognize the contrast of American culture against other lifestyles and social norms. Experiencing a new culture first hand has truly been enlightening.

Because of this, I have continually made efforts to have a more outgoing lifestyle. So far, I've backpacked through the streets of Europe with only a compass and a map to guide me, hiked with friends from sea to sea along the shores of Denmark, gone mushroom hunting while exploring the Swedish country side, attended soccer (called football here) games, sung at karaoke bars, moshed with metal-heads at a Korn concert, and had a great deal more amazing experiences. My life is filled with a new intensity and sense of purposeful fulfillment that I will certainly bring back with me to the states upon the conclusion of my studies here at Chalmers.

I would like to sincerely thank everyone involved in helping me partake in this incredible opportunity, including my supervisors Hans Theliander (Chalmers) and Arthur J. Ragauskas (Georgia Institute of Technology).



Tyrone Wells

From left to right: Arthur J. Ragauskas, Tyrone Wells

From left to right: Hans Theliander, Tyrone Wells, Art Ragauskas

Museum

IPST Museum of Papermaking Receives Award from Gomez Mill House

During the month of October, IPST museum director Teri Williams traveled to Saint Louis where she attended the annual meeting of the Friends of Dard Hunter, and then to New York where she participated in the gala event organized to celebrate the 300th anniversary of the Gomez Mill House. Williams accepted the organization's Pioneer Award on behalf of the museum.

Both organizations maintain long standing and significant relationships with the museum and are connected to the museum's founder, Dard Hunter. Since 1981, the Friends "has been connecting and educating papermakers in America and all over the world" and, as part of their mission, they support the Dard Hunter collection of the Robert C. Williams Papermaking Museum.

Built in 1714, the Gomez Mill House is located north of New York City and sits on Jew's Creek, a tributary of the Hudson River. It stands as the oldest Jewish residence in North America. During the Revolutionary War, it served as prominent center of patriotic activity. From 1912 to 1919, it belonged to Dard Hunter who, just prior World War I, built a paper mill on Jew's Creek. Students from all over the world came to learn from him as he made paper by hand, cut and cast type, and hand-printed his own books. The *Gomez Foundation for Mill House* restored Hunter's Mill and the mill dam and bridge in 1997. In 2010 the mill underwent a second major restoration. Dard Hunter figures prominently in the lore and history of this historic treasure.

IPST Museum Curator Attends Southeastern Museums Conference

Virginia Howell

In October, the Robert C. Williams Museum of Papermaking education curator Virginia Howell attended the Southeastern Museums Conference (SEMC) annual meeting in Savannah, Georgia. This gathering of over 500 museum professionals, students, and consultants from the southeast provided an opportunity to further develop professional practices and to establish relationships with other museums. Howell says, "Attending the conference gave me great ideas to bring back to the museum. Finding out how other organizations work with different audiences

Continued on next page – **Conference**

Conference

Continued from last page

provides new perspectives on museum education. I also was glad to find out more about methods of using technology to share our mission."

The keynote speaker was Dr. Stan Deaton, senior historian at the Georgia Historical Society. Dr. Deaton spoke about the role cultural institutions play in the larger community. Howell attended conference sessions on digitizing collections, on museums governed by larger organizations, and on ways to reach unique education audiences. She also attended a session on developing international partnerships for exhibitions. Evening activities included visiting the Savannah College of Art and Design, the Georgia State Railroad Museum, and the Savannah History Museum.

Calling All Alumni

Alumni Welcome to Keep in Touch

All alumni of the Institute of Paper Chemistry, Institute of Paper Science and Technology and Georgia Tech's Paper Science and Engineering program are invited to become members of the Paper Heritage Alumni Foundation. The alumni foundation's purpose is to serve alumni by engaging former students in active and effective partnerships with the IPST community and the industry. Governed by alumni, for alumni, the Foundation promotes mutually beneficial interaction between alumni and the current student body and offers the opportunity to build Institute friendships that will last a lifetime.

For further information, go to www.ipst.gatech.edu/alumni, or email Lavon.Harper@ipst.gatech.edu.

Institute of Paper Science and Technology
500 10th St. NW
Atlanta GA 30332-0620

http://www.ipst.gatech.edu