
Georgia Tech
Renewable Bioproducts Institute

Georgia Tech Renewable Bioproducts Institute

RBI: Graduate Research and Education

An Interdisciplinary Research Institute of Georgia Tech

Expertise
- Biorefining
- Biomaterials
- Nanocellulose
- Pulp & Paper

Experience
Five-Year Summary:
- 270 Refereed Publications
- 16 Patents Issued
- 15 M.S. & 36 Ph.D.

Endowment
- $44 Million
- Leverage for Innovation
- Cost-Share

Enterprise
- 2 Colleges
- 6 Schools
- 52 Faculty
- 90+ Laboratories

Georgia Tech Renewable Bioproducts Institute

RBI at a Glance

Serving the development of bio-based markets:

- Biochemicals
- Specialty papers
- Food & Beverage Packaging
- Biofuels
- Health & Hygiene
- Pharmaceuticals
- Automotive
- Electronics
- Advanced Materials

Broadening the research mission to advance the use of renewable raw materials in expanding markets

Drawing on the full range of Georgia Tech's relationships to help promote and capture the opportunities

Investing to repurpose core lab facilities for better alignment with the expanded research focus

Leveraging a significant endowment to understand the science, build the technology and train future leaders

Promoting an efficient, competitive, profitable bioproducts industry based on forest raw materials

Georgia Tech Renewable Bioproducts Institute

The Go-To Place for Bioproducts Research

Networking	Senior executives of lignocellulosics concerns
	Expert faculty resources, internationally networked
Exposure	Current and future research opportunities
	RBI and across Georgia Tech
Opportunities	Intra-industry/cross-industry collaboration
	Leverage of RBI endowment research
Grad Students	Mentoring opportunities
	Employment candidates

Sharpening the Line of Sight…

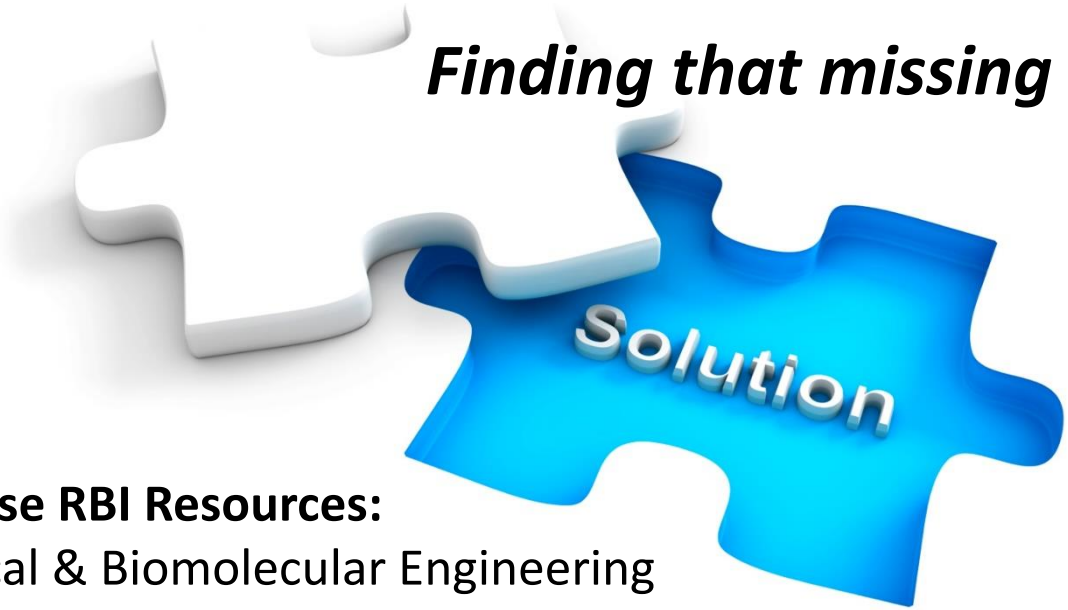
You have big ideas … and challenges.

We turn those ideas into reality with targeted research funding:

- Endowments
- Sponsorships
- Consortia
- Grants (Federal, Industry)
- State Budget

…From Ideas to Success.

Finding that missing piece…



With these RBI Resources:

- Chemical & Biomolecular Engineering
- Chemistry & Biochemistry
- Materials Science and Engineering
- Mechanical Engineering

In these categories:

- Bioprocesses, Bioproducts & Biomaterials
- New Materials & Applications
- Resource Efficiency
- Operational Excellence

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Georgia Tech Capability

- **900** full-time instructional faculty
- **21,500** undergraduate and graduate students
- Greater than **$700 million** in annual research expenditures
- **Top 10** in research expenditures among universities without a medical school

"[Because of RBI], our experts across Georgia Tech have a portal into the industry, with expertise on cellulose and its practically unlimited potential."
—Georgia Tech President Bud Peterson

"America has… high-quality private universities funded by states, such as Georgia Tech, which are world-class.
—The Economist, February 2015, p.42

Georgia Tech - Premier Expertise

- **Ranked No. 7** among public universities in the country (*U.S. News & World Report*)
- Consistently been named among the **5 best** undergraduate engineering programs
- **Ranked as No. 1** graduate and undergraduate industrial engineering program (24th consecutive No. 1 ranking)
- All 11 graduate engineering programs are in *U.S. News & World Report* **Top 10**
- **No. 1** smartest public college – *Business Insider Magazine*
- **Ranked 9th** in Engineering/Technology and Computer Science by Academic Ranking of World Universities, 2013

Georgia Tech's Mission and Strategy

Mission & Vision	• Technological change is fundamental to the advancement of the human condition… We will be leaders in improving the human condition in Georgia, the United States and around the globe. • Georgia Tech will define the technological research university of the 21st Century and be leaders in influencing major technological, social and policy decisions that address critical global challenges.
Strategic Plan	• We will be among the most highly respected technology-focused learning institutions in the world • Georgia Tech will sustain and enhance excellence in scholarship and research • We will continually expand our research portfolio and provide new products and processes, guided by industry priorities

"[RBI] is a model for all three elements—research partnership, education and impact—that we intend to propagate across campus."
—Steve Cross, EVP – Research, Georgia Tech

RBI and Georgia Tech – The Total Package

- Extensive experience in lignocellulosic research
- A portal into the spectrum of capabilities within Georgia Tech
- A facilitator amid faculty, schools, research institutes
- A forum for connecting partners throughout the supply chain

"The Institute is uniquely positioned to assist the forward-thinking company plan its future success."
—RBI Director Norman Marsolan

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RBI's Strategic Thrusts

Advancing the Bioeconomy

Strategic Research	Biochemicals and Fuels	Biomaterials	Operational Excellence
Education	World-class graduate education	Professional Master's Program	Industry connections and networking
Strategic Support	Leadership, Business, Policy and Sustainability	Interdisciplinary Research Centers	Testing Services

Georgia Tech Renewable Bioproducts Institute

Faculty Leadership in Innovation

Our faculty members are distinguished scientists,
who participate as active leaders in important discipline-centric associations
and win recognition from their peers and scientific organizations.

- More than **30 awards** to faculty members in recent years—including a Gunnar Nicholson Gold Medal Winner and a Fulbright Distinguished Chair designation
- **16 patents** and **270 refereed publications** in past 5 years
- **17 Fellow designations**, including Fellow of the American Association for the Advancement of Science
- And at least **5 appointments** to boards, councils and commissions




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Strategic Research

2015 Fellowship Awards

Biorefining

Process Systems Engineering of Novel Mild Chemical Pretreatment Options of Lignocellulosics
Andreas Bommarius & Matthew Realff

Multimode Micro/Nanoscale Imaging to Enable Enhanced Pulp Washing
Andrei Fedorov

Nanocellulose-based Biomimetic Chemocatalysts for Conversion of Furan Compounds to Fuel
Chris Jones

Rapid Reliable Optical Analysis of Cellulose Nanocrystal Morphology/Size
Ken Sandhage & Robert Moon

Mechanocatalytic Depolymerization of Lignin over Kaolin-Based Catalysts
Carsten Sievers

Strategic Research (cont.)

2015 Fellowship Awards

Biomaterials

High Performance Barrier Coating Packages from Well-Designed Inkjet Printing Using Cellulose Nanocrystal-Polymer Composite
Jerry Qi & Yulin Deng

Protein-Assisted Functional Active Packaging for Safety and Security: The Intersection of Cellulosic and Fungal Hydrophobins with Semi-Conducting Polymers
Paul Russo & Elsa Reichmanis

Tensegrity-Inspired Microstructures for Cellulose Nanocrystal Composites in Film and Packaging Applications
Meisha Shofner

Bio-Inspired, Ultra-Strong Biopolymer-Based Nanocomposites
Karl Jacob & Hamid Garmestani

High Performance Cellulose Fibers Based on Cellulose Nano Crystals
Satish Kumar & Robert Moon

Strategic Research (cont.)

2015 Fellowship Awards

Operational Excellence

Fiber Orientation in Multiphase Forming Technology
Cyrus Aidun

Advanced Froth Flotation for the Separation of Water-Soluble and Mildly Hydrophobic Contaminants from Aqueous Pulps and Slurries
Sven Behrens & Carson Meredith

Strain Field Mining: The Key to Engineering the Strength and Fracture Toughness of Paper and Packaging Products
Christopher Muhlstein

Effect on Strain of Repassivation and Corrosion Behavior of Duplex Stainless Steels in Pulp and Paper Mill Environments
Preet Singh

Research Capabilities

Bioprocessing

Biorefining

- Oxidative, catalytic, enzymatic, and biological refining processes
- Lignocellulose pretreatment for biofuels
- Green chemistry of biopolymers including cellulose, hemicellulose, lignin

Pulping & Papermaking

- Energy-saving technologies – membranes; evaporation
- Pulping and bleaching improvements; recycling
- Corrosion processes and models

Sustainable Manufacturing

- Business & supply chain
- Manufacturing excellence
- Energy & resource efficiency
- SMART Manufacturing
- Corrosion & Reliability

Biotechnology

- Nanomaterial synthesis, characterization, and measurement
- Polymer synthesis
- Colloid and surface science and engineering

Research Capabilities

Bioproducts

Pulp, Paper, Packaging, Tissue

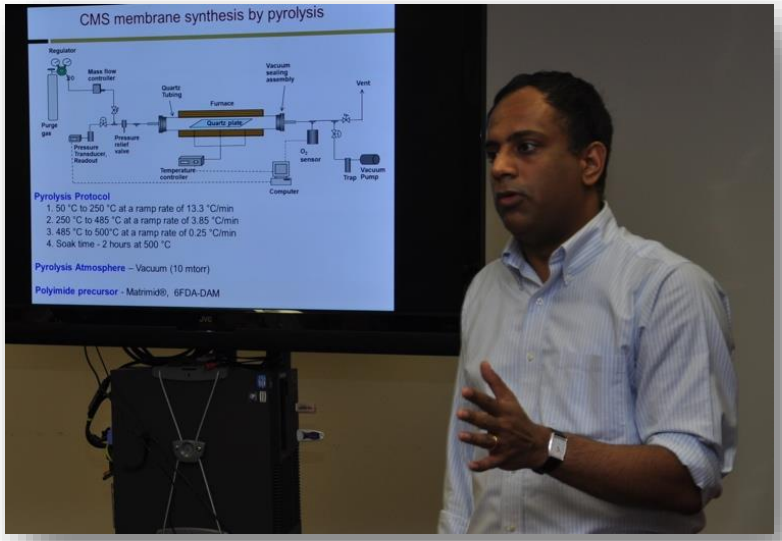
- Paper forming technologies for advanced products
- Paper physics and properties
- Advanced packaging
- Tissue properties and product development

Biochemicals

- Biofuel
- Bio-based feedstocks
- Lignin-based products

Biomaterials

- New nanocellulose- and hemicellulose-based materials and properties
- Fabrication of novel devices and applications - Sensors, solar cells, printed electronics, medical applications
- Composite materials



RBI Laboratory Investment

RBI spending from
2009 to 2015
on new analytical
and research equipment:
$1.7 million
Major laboratory and facility
upgrades are planned for the
next three years.

RBI provides significant laboratory space
dedicated to specialized bioproducts research

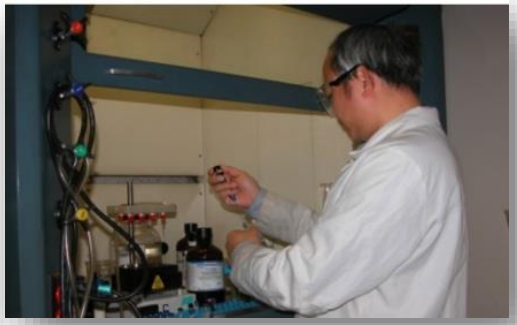
Analytical and Testing Capability

Chemical Analysis

- Machine deposit, evaporator scale and product contaminant chemical characterization; wood, pulping liquor, pulp and paper chemical analysis; product defect analysis; methods development
- Instr. Analyses: gas and liquid chromatography, mass spectrometry, infrared spectroscopy, emission spectroscopy and capillary electrophoresis
- Wet chemistry: titrimetry, gravimetry

Paper Physical Analysis

- Tests for strength, optical, surface and structural properties
- Special services in areas such as environmental simulations and accelerated aging
- Surface analysis, paper *z*-direction analysis, electron microscopy
- Trouble-shooting of packaging, in collaboration with Chemical Analysis and Pulping Labs, with environmental chambers for temperature and humidity conditions



Pulping, Bleaching and Chemical Recovery

- Raw Materials and Pulps: Chip analysis, pulp quality; computer-controlled handsheet press; simulations; mini-digester, shear mixer
- Recovery: Weak BL concentration; precipitation/ analysis of crystals
- Combustion chemistry: Laminar entrained-flow reactor (LEFR) to burn and analyze small particles (~100 microns) of black liquor, biomass and other materials; thermo-gravimetric analyzer to study gasification and combustion; gas chromatography

Members obtain testing services at a discounted rate.

Georgia Tech Renewable Bioproducts Institute

The Evolution of RBI

What is our next milestone together?

March 2015
Inaugural RBI Executive Conference

October 2014
Launch of RBI

May 2014
Endowment; Institute Redesign

August 2013
Industry 10-Year Review

July 2003
Merger with Georgia Tech

Value Propositions

What RBI offers

- World-class expertise in materials science, chemistry, and engineering to unlock the untapped potential of forest- and agriculture-based lignocellulosic biomaterials across the industry
- Interdisciplinary, cross-industry research capabilities to solve problems relevant to business mission
- Networking forums across the forest bioproducts manufacturers and users
- Opportunities to leverage endowment-sponsored graduate research on company priority investigations
- Development and advanced education of leaders for renewable biochemicals and bioproducts companies of the future

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Contract Continuum:

4 Contract Mechanisms Tailored to Meet Industry Needs

Basic Research Agreement	• Exploration of potential solutions in a broad technical area • Non-exclusive default IP license • Option to negotiate exclusive license IP
Applied Research Agreement	• Identify solutions to targeted problems • Non-exclusive default IP license • Exclusive rights in return for single fee at contract signing
Demonstration Agreement	• Development of incremental improvements for an existing technology: company or licensed GT IP • All improvements licensed ***without*** additional fees
Specialized Testing Agreement	• Access to unique GT technical assets to evaluate new and existing products • Sole deliverable is test report: no IP rights transfer

The Value of Partnership

Concierge Service

We serve as the bioproducts portal into Georgia Tech.

One-Stop Shopping

RBI has everything needed in an internationally recognized science and engineering institute.

Flexible Contract Models

You decide which one works for you. Focus currently emphasizes partnership and company-specific research. Shared consortium arrangements are available.

What Makes Us Different

- Interdisciplinary, cross-industry center within an internationally recognized institute
- ***9 decades*** of deconstructing lignocellulosic materials
- $44 million endowment and 50 graduate research fellows to leverage company investments, federal match
- Strong support from the state for an institution supporting a major employer history
- Federal connections (*e.g.,* agriculture, aerospace, energy and power, defense)

What Companies Tell Us

We need more efficient separation technology.

The cellulose value is that it is CELLULOSE.

We need renewable materials applications.

We're a small company; we need capability.

We want to be more sustainable.

We need mill solutions.

How can we create more value with less?

We need new materials with better performance.

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RBI Member Companies

FY 2014-15

AkzoNobel

AMERICAN PROCESS

ARAUCO

Domtar

Georgia-Pacific

GRAPHIC PACKAGING CORPORATION

IMERYS

INTERNATIONAL PAPER

KAPSTONE PAPER AND PACKAGING CORPORATION

Kimberly-Clark

MWV

NALCO An Ecolab Company

Renmatix

sappi

SOLENIS Strong bonds. Trusted solutions.

UPM

VERSO

Weyerhaeuser

Member Benefits

- Insights into vision and future research needs of industry
- A first-hand look at emerging industry opportunities
- Concierge entrée into Georgia Tech
- Conferences and workshops with bioproducts and other industry representatives
- Cross-industry, multidisciplinary networking
- Consortium research opportunities
- Introduction to graduate students and their research
- A cost-effective investment: Annual dues $10,000

Working Together to Succeed

Collaborating with industry to promote success in the bioeconomy

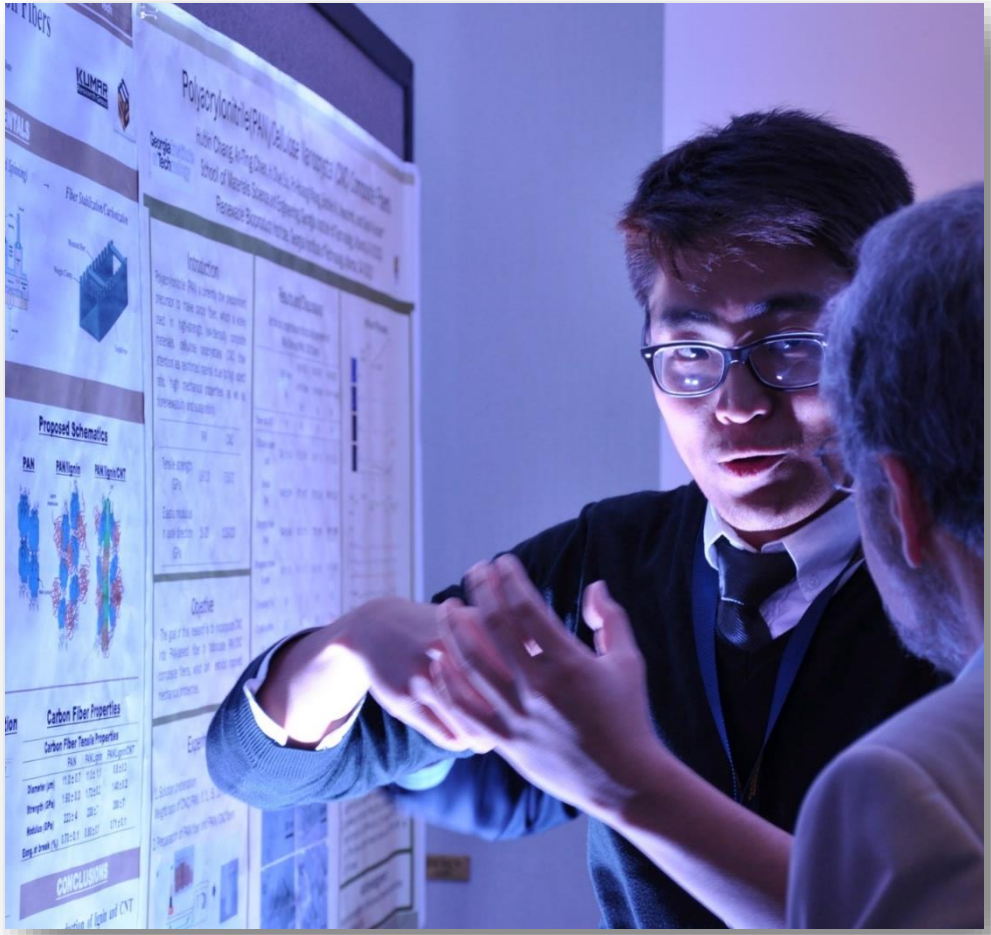
RBI is redesigning itself to become an even more **valued partner** to forward-looking organizations in the bioeconomy

We are sharpening the line of sight between your imagination and ideas and **your organization's success**

Together, we are **advancing bioproducts industries**

We look forward to **welcoming you** to membership

Join us.
Create the future.



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