Institute of Advanced Materials & Technology (i-AMT)

Director: Alex Jen

The University of Washington
http://depts.washington.edu/iamat/
Founded 2006
Vision

To discover, design and develop

advanced materials to benefit society
Mission

- To work at the intellectual frontiers, and to achieve excellence, in materials research
- To create synergy between researchers working in all areas of materials research on campus
- To enhance UW materials research through active integration of fundamental research and technology transfer
- To nurture entrepreneurial aspirations of researchers and encourage them to be imaginative in translating discoveries into products for the marketplace.
- To serve as a broker between the academic and business community to convert research discoveries to practical commercial products.
**Governance**

- **Director:** Alex Jen
- **Assoc. Director:** Dan Schwartz
- **Asst. Director:** Hanson Fong

**Scientific Thrusts**

- **Energy**
  - Sam Jenekhe*
  - Guozhong Cao**

- **Photonics and Optoelectronics**
  - Larry Dalton*
  - David Ginger**

- **Biomaterials and Bionanotechnology**
  - Buddy Ratner*

- **Multifunctional Composites**
  - Mark Tuttle*
  - Raj Bordia*
  - Kuen Lin**

**Executive Committee**

* Thrust Leaders; ** Associate Thrust Leaders
Intellectual Property Advisory Board

Rick LeFaivre (OVP Ventures Partners)

Graham Mott (Global Brand Innovation & Business Creation; Philips Oral Healthcare)

John Reagh (Washington Research Foundation)

George Renzoni (Christianson, O’Conner, Johnson & Kindness)

Keith Ritala (College of Engineering & i-AMT, UW)

Rad Roberts (College of Arts & Science, UW)

Fiona Wills (UW Tech Transfer)
Goals & Strategies

Research

- Take Leadership in Judiciously Selected Research Areas
- Establish Interdisciplinary Research Facilities
- Promote Interdisciplinary Research Activities
- Establish UW as a National Leader in Materials Research
- Generate Licensable Technologies

Translation

- Identify Technologies Ready for Commercialization
- Facilitate the Transition from Discovery to Commercialization
- Promote Industrial Partnerships
- Successful Licenses and Starts-up Companies from Discoveries Made in i-AMT
### Research Strategies

<table>
<thead>
<tr>
<th>Establish Leadership in Judiciously Chosen Research Areas</th>
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<tbody>
<tr>
<td><strong>Research Thrusts:</strong></td>
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<tr>
<td>1. Photonics/Optoelectronics</td>
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<td>2. Biomaterials and Bionanotechnology</td>
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<td>3. Energy</td>
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<tr>
<td>4. Multifunctional Composites</td>
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<tr>
<td>• Matching funds &amp; Proposal Endorsements</td>
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<tr>
<td>• i-AMT led research grants in these Thrust areas e.g. NSF-IGERT on Bio-Energy; DOE-Solar America Initiative</td>
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<table>
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<tr>
<th>Establish Interdisciplinary Research Facilities</th>
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<tr>
<td>12,000 ft² of research space in Benjamin Hall building:</td>
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<tr>
<td>1. Interdisciplinary Research Labs</td>
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<td>2. Shared Instrumentation Facilities</td>
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<td>Space will be ready by end of 2008</td>
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<th>Promote Interdisciplinary Research Activities</th>
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<tr>
<td>• Sponsor activities to promote interdisciplinary research &amp; education:</td>
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<tr>
<td>1. Nanophotonics for Breakfast Seminar Series</td>
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<tr>
<td>2. Intensive Courses in NanoScience and Nanotechnology @ PNNL</td>
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<td>3. i-AMT Distinguished Seminar Series</td>
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<td>4. Energy &amp; Environment Seminar Series</td>
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<td>• Leverage hiring of key faculty in COE and A&amp;S</td>
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Photonics/Optoelectronic Materials & Devices

- Develop transformative materials and devices for next generation information technology and sensing.

Achieved unprecedented low drive voltage in high-speed E-O modulator devices using UW E-O polymers

Courtesy of M. Lipson
Biomaterials & Bionanotechnology

UWEB (A NSF-funded ERC): Nanostructured scaffolds for tissue engineering

Multifunctional nanoparticles for applications in imaging/sensing and drug delivery

GEMSEC (A NSF-funded MRSEC): Genetically engineered peptides to fabricate materials with better biocompatibility

Particles consisting of a Cu$_2$O core surrounded by a protein shell self-organize on circular DNA (Courtesy of D Schwartz)
To develop alternative energy technologies with long-term sustainability and minimum environmental impact

Newly funded NSF IGERT on Bio-Energy (Courtesy of D Schwartz)

Well-defined nano-porous structures for applications in fuel cells/batteries/capacitors (Courtesy of G Cao)

Large area solar cells for renewable energy

A solid state lighting company based on UW technology (Courtesy of AES)

High efficiency solid state lighting by organic LEDs
Next Generation PV Cells Research at UW

• >$4M current research funding

• >$1.5M in facilities/equipment from DoD, Murdock Foundation, and Intel for organic PV

• DOE BES: $900,000 (07-10) (Jenekhe, Cao, Ginger)

• DOE Solar America Initiative: $900,000 (08-11) (Jen, Luscombe, Rehr, Ginger, Ma)

• NSF Center for Materials and Devices for Information Technology ($40 M/10 yrs)

• Multiple single PI NSF Grants

• Currently is competing for DOE’s Frontier Energy Center (~$4 - 5M/yr funding)
Multifunctional Composites

To develop multifunctional composites beyond the traditional structural applications—tailored material properties for specific performances/functions

Smart Multifunctional Composite Design (Courtesy of R. Bordia)  
Advanced fiber reinforced composite (Courtesy of K Lin & B Flinn)
Multifunctional Composites: Green Aviation

• Design aircraft with lighter weight, and lower operating cost, noise, nitrous oxide emissions, fuel burn rate.
• Include environmental constraints at early design stage.
• Multi-criteria Design Optimization (MDO) problem needs powerful optimization algorithms and simulation software that uses finite element analysis.
• “Silent aircraft” (Cambridge-MIT)
iAMT Partners: Complementary Strengths

- **CMDITR**
- **AMTAS**
- **UWEB**
- **GEMSEC**

**Nanotechnology Center**
• NSF Science and Technology Center (STC), UW is the lead institution, which includes Georgia Tech, Arizona, Caltech, Maryland, Cornell, Central Florida, Norfolk State University
• Develop transformative photonic and electronic materials and devices based on molecular (organic) building blocks
• First five year phase: 18MM, second five years 20MM (07-12)
• CMDITR involves over 300 students, faculty, post docs and staff
• CMDITR is one of eleven STC’s across the US
• Faculty from Chemistry, Physics, Optical Sciences, Materials Science & Engineering, Mechanical Engineering, Electrical Engineering, Applied Physics Laboratory, Chemical Engineering
UWEB: UW Engineered Biomaterials (B. Ratner)

- NSF, Engineering Research Center (ERC)
- “Biomaterials that Heal”
- Eleven years (1996-2007), 35MM plus (total costs)
- Cross-disciplinary team of materials scientists, molecular biologists, biomolecular engineers, biomaterials researchers, bioengineers and physicians, as well as industry leaders in the biomaterials field.
- Three-way partnership involving academe, industry, and NSF
- 20 companies, 100 students, 25 Faculty, 20 technical staff
Center for Nanotechnology (F. Baneyx)

- Established through the UW’s University Initiatives Fund (1997)
- Nanotech User Facility (NTUF) advanced characterization and fabrication instruments and equipment; one of 13 in the National Nanotechnology Infrastructure Network (NNIN)
- Research focus on producing nano safe products
- 75 faculty from Chemistry, Physics, BioEngineering, Chemical Engineering, Electrical Engineering, Materials Science and Engineering, Biochemistry, Genome Sciences, Physiology, Biophysics, Microbiology
AMTAS: Advanced Materials in Aircraft Structures (M. Tuttle)

- Federal Aviation Administration Center of Excellence (2003), UW lead institution
- 10 years, 1.5-2 MM/yr (FAA & 1:1 matching from non-federal sources)
- Consortium of academic institutions, aerospace companies, and government agencies
- Address safety and certification initiatives for existing, near- and long-term applications of composites and advanced materials for large transport commercial aircraft
- 3 academic institutions, 12 industry partners
GEMSEC: Genetically Engineered Materials Science & Engineering Center (M. Sarikaya)

- NSF grant (2005)
- Six years, 7.7MM (UW matching)
- Research to adapt and develop molecular biology and genetics protocols to engineer peptides and proteins
- Marry the science and technology of the two fields, biology and materials sciences and engineering
- Develop and establish Shared Experimental Facilities for interdisciplinary research
- 11 Faculty, 3 industry partners
Shared Instrumentation Facilities (SIF) (M. Hochberg)

- Integrate functions of existing and new facilities to provide strong capabilities in gaining fundamental understanding and cutting-edge devices, subsystems, and applications for translational research.

- Develop sustainable user-fee based facilities to provide well maintained and state-of-the-art instruments.

- Establish partnership with WTC, Nanotech User Facilities (NTUF) and the new Institute of Molecular Engineering at UW.
Shared Instrumentation Facilities (SIF)

**SIF 1. Shared Optoelectronic Device Test Facility**
to provide testing capabilities for nanoscale Si and hybrid photonic devices (The proposal is being evaluated by the Murdock Foundation)

Images show integrated silicon devices from Luxtera with couplers, fabricated in a commercial foundry by Luxtera Corp. (Courtesy of Luxtera)

**SIF 2. High Throughput Electron Beam Lithography Facility** for fabricating nanostructures with high reproducibility over large areas at high speed ($2.5 M NSF MRI proposal with $1.2M matching from Washington State EDC)
SIF 3. *Inert Atmosphere System* for Fabrication and Characterization of Thin-Film Organic Electronics and Photonics (obtained $1M from DoD DURIP & Murdock Foundation)

SIF 4. *Multi-user Facility for Synthetic Scale up and Purification* in Benjamin Hall Building
Institute Facilities and Space

- 12,000 ft² of space in Benjamin Hall Building
  - Dedicated and shared space for translational research
  - Space for state-of-the-art laboratories for interdisciplinary research
  - Space for Shared Instrumentation Facilities
  - Space for offices and a conference room

- 6,000 ft² of newly renovated wet chemistry labs in Bagley Hall

- DURIP and Murdock Charity grants for organic electronic fabrication and testing drybox; cryogenic facility
Translational Strategies

Promote Industrial Partnerships and Collaborations:
- Partnerships with Intel, Boeing, Micron, Lumera and other industrial companies in the NW region
- Promote research capabilities & discoveries through active marketing

Identify Technologies Ready for Commercialization:
- IP Advisory Board review of selected discoveries
  - Commercial potential
  - Applications & Markets
  - Patent strategy
  - Links to licensees & research partners
- Work with inventors to facilitate patenting & commercialization

Facilitate the Transition from Discovery to Commercialization:
- ~3000 ft² of industrial lab suites, shared instrument facilities, & office space to support translational research
- Identify critical market needs in thrust areas & develop research programs to address

Toward functioning as an incubator for UW inventors!
Initial Industrial Partnerships

Intel - UW research partnership in high-efficiency solar energy high-speed EO modulation research

Boeing – UW partnership to develop materials and devices to next generation aviation needs

Build on established Lumera – UW partnership to expand into new electro-optic and protein array technology
**Possible Models for i-AMT**

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<tr>
<th>Model</th>
<th>Pros</th>
<th>Cons</th>
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<tr>
<td>Consortium</td>
<td>• Membership fees are unrestricted</td>
<td>• Dilution of exclusive licensing opportunities</td>
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<td></td>
<td>• Wide range of potential member cos.</td>
<td>• Fees may prohibit small companies from joining</td>
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<tr>
<td>Federally-supported Research Center (e.g., I/UCRC, STC, DOE Frontier Energy Center)</td>
<td>• Leverage industry research funding to attract federal $$</td>
<td>• Highly competitive review process</td>
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<td></td>
<td>• Validates mission</td>
<td>• Unlikely to cover entire range of technologies</td>
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<td>Incubator</td>
<td>• Provides a platform for spin-off &amp; start-ups</td>
<td>• May need to operate separately from UW</td>
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<td>• Strong need exists in Seattle area</td>
<td>• Start-up funding req’d. until self-sustaining</td>
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Next Steps

• Form Scientific Advisory Board
• Identify and pursue potential funding sources
• Establish policies for handling confidential & proprietary information
• Host ‘Open House’ workshop to link researchers with industry