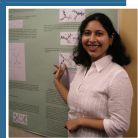
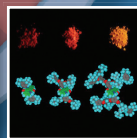
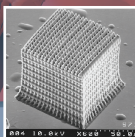
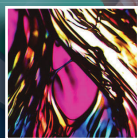
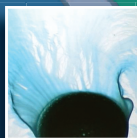
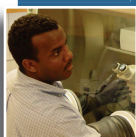


Center on Materials and Devices for Information Technology Research



University of Washington | University of Arizona | Georgia Institute of Technology



An NSF Science and Technology Center No. DMR 0120967



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Director's Welcome

Welcome to the Center on Materials and Devices for Information Technology Research!

We are a National Science Foundation (NSF) funded Science and Technology Center (STC) that focuses on photonics and information technology. The purpose of this notebook is to provide you with an introduction and a guide to the CMDITR, the research being conducted by our participating members, and the opportunities you have as a member.



STCs are unique among NSF initiatives in that they fund long-term research and educational activities in order to encourage innovation, information and technology transfer, as well as interdisciplinary activities. Accordingly, the CMDITR's mission is not simply to research photonics and information technology, but also to enable the commercialization and spread of new technology as it is developed, as well as create new educational resources and a better trained, more diverse, workforce. The CMDITR reaches these goals through the tangible research, programs, and resources that are created by all of our members.

Please look this handbook over carefully and if you have any questions, feel free to contact one of the CMDITR coordinators at your respective institution.

Sincerely,

A handwritten signature in blue ink that reads "Larry R. Dalton".

Larry Dalton

Director





Overview



The Center on Materials and Devices for Information Technology Research (CMDITR) is part of a major National Science Foundation (NSF) initiative to “enhance the nation’s economic competitiveness” through the creation of Science and Technology Centers (STCs). These Centers provide unique research and educational opportunities that foster innovation and advancement as well as ensure the transition of such advancement into the broader society.

One of six STCs funded in 2002, CMDITR will receive 18.4 million dollars of funding over five years (\$3.64M per year). This funding is spread amongst approximately eight collaborating universities, including the three primary partners: The University of Washington (UW), where the Center is headquartered; The University of Arizona (UA); and Georgia Institute of Technology (GT). Collaborations with minority institutions participating in the Alliance for Nonlinear Optics (ANLO) and historically black colleges and universities (HCBU), such as Norfolk State University, represent additional partnerships critical to the Center’s success. Industry affiliates and Federal Research Laboratories also provide Center support, either directly or indirectly.

Over 300 researchers within the Center are working on the leading edge of photonics research using novel organic materials to produce, capture and modulate light. CMDITR research has the potential to revolutionize the IT industry which continues to be a fast growing, dominant component of the world economy.



Vision

This Center will lead a revolution in the development of new photonic materials and devices for information technologies of the future through the integration of science and engineering research, education and diversity enhancing programs.

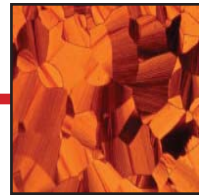
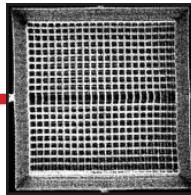
Impacts

Advances in photonics have the potential to vastly increase available bandwidth, allowing for ultra-fast communications over a new optically-based network.

As sensing applications in IT grow, new photonic materials and devices will lead to next-generation radar, navigation, and energy management systems to enhance our nation's defense capabilities, stabilize our power grid, and transform transportation and space exploration.

A new organic materials platform will allow production of light-weight, ultra low-cost and flexible devices using printing and soft lithography for:

- New IR light-sources for optical interconnects
- Stable organic semiconductors with large charge mobility
- OLED devices for displays and lighting
- Organic circuits that integrate light sources, photodetectors, and transistors on plastic substrates
- Photovoltaics



Mission

Our mission is to deepen our understanding of the electrical and optical properties and organizational structure of novel organic and hybrid materials and to apply that knowledge to the rational design of new materials and devices for a broad spectrum of breakthrough applications in telecommunications, computing, lighting, energy, transportation, medicine, and defense. Our research efforts will encompass education and diversity enhancement, thereby developing human potential to ensure that IT research and development remain at the forefront of emerging technologies.

Goals

- Develop new and “disruptive” technologies based upon new organic and hybrid materials, processed into photonic and electronic devices at low cost
- Create a better-trained workforce in the area of materials and devices for information technology, and improve the diversity of that work force through proactive recruiting and innovative web-based cooperative learning
- Formulate cooperative research and development agreements, intellectual property agreements, and personnel exchanges to promote inter-university and university/industry/federal laboratory interactions
- Create new opportunities for providing interdisciplinary, hands-on education by facilitating exchange of students amongst groups with diverse research capabilities and interests
- Design, implement, and assess new educational approaches that provide more flexible and accessible career pathways for students
- Provide responsible conduct of research training through lecture, discussion, and a web-based certification process to all members

Commitment to Education

The CMDITR has created interdisciplinary, multi-institutional educational programs and resources that are directly tied to the research expertise of Center investigators. For example, our faculty and student exchange



program allows members to network, creating novel cross-institutional educational opportunities that would not otherwise be possible.

We are currently developing novel educational materials for graduate-level courses that will provide an opportunity for all Center graduate students to gain knowledge of the breadth and scope of CMDITR research. These flexible,

interdisciplinary modules will be shared with other interested academic departments, industry affiliates, and specifically, Norfolk State University (NSU). The Center's Research Experiences for Undergraduates (REU) Program brings students from across the country into CMDITR labs, engaging them in interdisciplinary projects designed to expand on their existing knowledge-base and strengthen their commitment to pursuing a career in science and engineering. *More information about the Education and Partnership Program can be found at: www.stc-mditr.org/education*

Commitment to Diversity

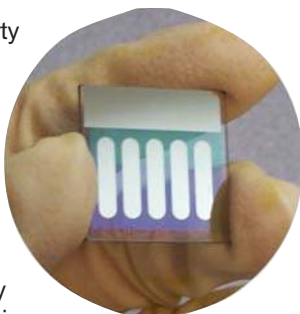
Increasing diversity within our Center and the field of science and engineering in general is amongst the CMDITR's highest priorities. To increase the diversity of its funded members, the Center will:

- Recruit highly talented faculty from underrepresented groups
- Recruit graduate and undergraduate students from underrepresented groups and direct funding toward assistantships and fellowships for women and minorities
- Provide **all** participants a supportive environment and mentoring appropriate to their career objectives

Beyond impacting our center's diversity, the CMDITR has an obligation and commitment to develop proactive programs that significantly improve diversity within the science and engineering fields related to our research. Examples of current programs include our collaboration with Norfolk State University to assist in the implementation of a new Ph.D. program in Materials Science and Engineering; and our growing partnership with the GEM Consortium, a national non-profit organization that provides fellowships to underrepresented minority students.

Intellectual Property and Technology Transfer

Development of intellectual property leading to commercialization and large-scale economic impact is one of the truly unique aspects of the CMDITR. To support intellectual property management, researchers from each of the Center's institutes work with their university's Office of Technology Transfer to disclose and patent the CMDITR's many revolutionary discoveries. Intellectual property activities have already far exceeded initial expectations with 24 provisional and utility patents filed within the Center's first three years.



Center Management

The very nature of CMDITR's interdisciplinary, multi-institutional research and strong commitment to education and diversity enhancement programs requires a different approach to management and collaboration.

As such, the Director is advised by several committees and boards specifically constituted to ensure broad input. The Center's Strategic Advisory Board (SAB) consists of 14 representatives from industry, research universities, government laboratories, and institutions with significant populations from underrepresented groups. An Educational Advisory Committee also exists to provide external guidance in the Center's educational program design and implementation.

In addition, the Center's management team meets bi-weekly via video-conference to provide operational oversight and recommendations regarding the Center's research. Graduate students and postdocs are currently in the process of constituting their own council to improve communications within this large population. Finally, recognizing the importance of gaining feedback and insight from all Center members, the CMDITR hosts an annual meeting to engage members in all aspects of Center operations.

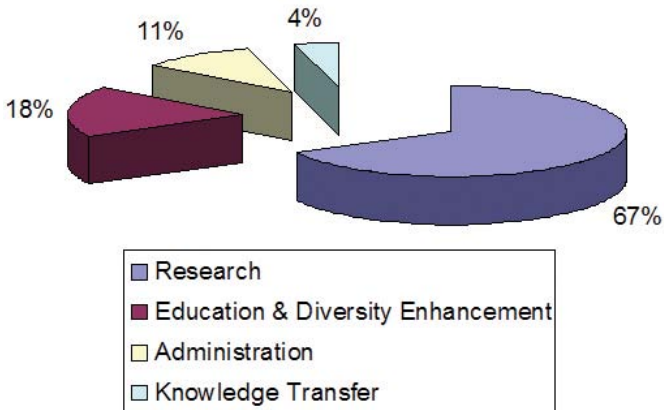
An organizational chart and full list of Strategic Advisory Board and Management Team members can be found in Appendix 1.

Budgeting for Success

Of the \$3.64M that CMDITR receives from NSF annually (\$18.4M over five years), approximately 67% goes to support the Center's research activities. Over half of the research budget (or 44% of the overall NSF budget) is used to support graduate students and postdoctoral investigators. The remainder is used to fund education, diversity enhancement, and knowledge transfer activities as well as administrative needs.

In addition to this federal funding, each of the universities in the Center's cooperative agreement contributes a 30% cost share. These matching funds are typically used to support administrative functions, hiring of new faculty in research areas within the Center, and facilities improvement.

Additional support comes through monies gifted to the Center by our Industry partners. Through our Industrial Affiliates Program (IAP), member companies help support the Center by contributing to a discretionary gift fund that supports educational programs and defrays meeting costs.



Of the 3.64 Million dollars received from NSF in Year 3, 65% was spent on research. Over 50% of research funding was used to support graduate students

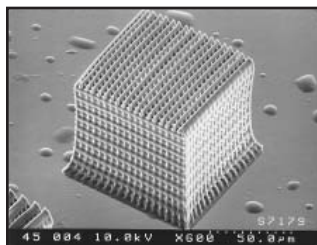
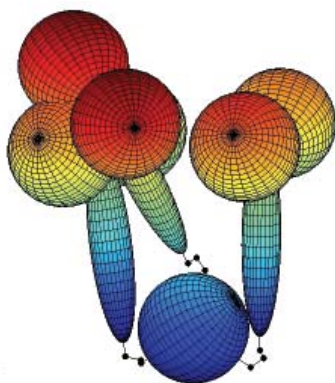
Research & Facilities

The CMDITR researches novel engineered (organic, hybrid, and nanostructured) materials for next generation information technology (IT) applications. Researchers come from a broad spectrum of traditional disciplines including chemistry, physics, materials science and engineering, optical sciences, electrical engineering, and mechanical engineering. Their talents range from theory to implementation, thus enabling an efficient “end-to-end” paradigm that starts with molecular design and ends with the fabrication of micro and nano-engineered integrated devices. The science and engineering being accomplished by CMDITR and the rate at which it is accomplished could not be achieved following a single-investigator model. Our progress is truly a reflection of a Center-mode of operation.

The Center’s research strategy follows two main thrusts:

- **Electro-Optic and All Optical Switching Materials & Devices**
- **Light Sources and Organic Electronics.**

Each thrust has a designated leader who provides oversight and coordination of 15-20 PIs. This section gives a brief overview of each research thrust and the work being done throughout the CMDITR. A full list of funded PIs, including a photo and brief description of their research can be found in Appendix 2. Additional details can be found on the CMDITR website at www.stc-mditr.org.



A complete listing of Researchers by thrust and research area can be found in Appendix 2.

Electro-Optic and All-Optical Switching Materials and Devices (EO&AOS)

Thrust Leader: Alex Jen, University of Washington

This program investigates the use of non-linear optical chromophores in novel organic supramolecular frameworks to develop “disruptive” electro-optic (EO) and all-optical (AO) switching devices. Optimization of such materials with respect to alignment, tunability (conductivity, refractive index), temperature and photochemical stability, and mechanical properties is crucial to the development of devices for light-weight, low drive voltage, and ultrahigh-speed information processing. In order to realize our goals we utilize an “end-to-end” cross-disciplinary approach connecting theory, material synthesis, processing, and device design and fabrication. We attempt to optimize the EO activity of materials through improved poling efficiency of NLO chromophores and supramolecular materials based on theoretical design considerations.

Thus far, we have demonstrated:

- The importance of quantum mechanical calculations in guiding and explaining improvements of molecular hyperpolarizability
- The use of statistical mechanical calculations to guide the improvement of macroscopic electro-optic activity to record level, and to suggest structures that would lead to perfect or nearly perfect ferroelectric order
- Electro-optic activity exceeding 300 pm/V at telecommunication wavelengths
- Integration of “silicon photonics” with organic electro-optics
- Important new mechanisms of lattice hardening to improve the thermal stability of electro-optic materials
- 5 orders-of-magnitude improvement of the photostability of OEO materials in materials with EO activity > 80 pm/V
- New microresonator device structures relevant to a range of applications
- Terahertz signal generation and detection with record sensitivity
- New third order (AO) materials and application to development of frequency-resolved optical grating (FROG) devices and image correction
- A low-cost, compact, portable device for ultra-short pulse characterization by FROG using efficient third harmonic generation (THG) in organic molecules

Visit the EO&AOS Website at: www.stc-mditr.org/research/eoaos

Light Sources and Organic Electronics (LSOE)

Thrust Leader: Bernard Kippelen, Georgia Institute of Technology

This program exploits new chemistries to control and improve charge transport, charge injection, and light emission for the processing, storage and display of information in order to develop an organic materials platform that will enable the fabrication of low cost, large area, printable electronic circuits on plastic substrates.

New materials under development consist of organic and hybrid materials with tailored morphology, including dendrimers, self-assembled mesophases, polymeric materials processed from solution, and semi-crystalline thin films processed by physical vapor deposition. Devices under investigation are: integrated waveguides with optical gain, organic light-emitting diodes, organic field-effect transistors, memories, capacitors, photodiodes and solar cells. These devices are then incorporated into displays, image sensors, radio frequency identification tags, among others.

The key scientific challenges addressed by this thrust are to:

- Develop structure-property relationships to optimize the optoelectronic properties and the stability of organic and hybrid materials
- Control processing of new materials and ensure their compatibility with other organic and inorganic interfaces
- Control factors that determine nanoscale morphology
- Evaluate patterning approaches that enhance a given physical property and/or provide new functionality

Thus far, we have demonstrated:

- A room temperature electron mobility $>1 \text{ cm}^2/\text{Vs}$ using the space-charge limited current technique in self-assembled columnar discotic liquid crystalline materials
- An organic polycrystalline solar cell with 3.4 % power conversion efficiency, max. quantum efficiency of 68% at 680 nm
- Oligoquinolines as efficient new n-type blue emitters
- Photopatterning of dendrimers
- Organic field effect transistors with improved mobility and on-off ratios (n-type OFETs with field-effect mobilities of $0.65 \text{ cm}^2/\text{Vs}$ using purified C60)
- Fabrication of micro-structured plastic optical fiber

Visit the LSOE Website at: www.stc-mditr.org/research/light_sources

Facilities

The CMDITR has developed several state-of-the-art facilities to support its research objectives. These include a **Network Linux Cluster** consisting of 40-processors, a **Hyper-Rayleigh Scattering (HRS) Facility**, a **Synthetic Scale up and Purification Facility**, and an **Organic Electronics Facility**.

HRS facility apparatus is based on a Ti:sapphire pumped optical parametric oscillator that provides output from 1.1 to 2.5 μm . This system has been used to provide estimates of approximately 16 chromophores recently developed by researchers involved in the CMDITR.

Contact: Phil Reid, University of Washington
preid@chem.washington.edu

Synthetic Scale-up and Purification Facility (480 sq. ft.) provides synthetic capabilities for preparation of materials on quantity scales and purity compatible with device fabrication. The facility is equipped with fume hoods with vacuum and gas lines, scale-up organic solvent distillation and purification systems, analytical and preparative mode gel permeation chromatography systems with a variety of columns (Waters Breeze HPLC System, Waters Corporation), medium pressure silica-gel based chromatography columns, and large scale laboratory glassware. More common organic laboratory equipment such as vacuum and drying ovens, recirculating chillers, refrigerator/freezer, rotary evaporator, balances, stirrer hot plates, and chemical and solvent storage systems is also available.

Contact: Alex Jen, University of Washington
ajen@u.washington.edu

Organic Electronics Facility comprises an automated high-vacuum deposition system with four organic sources and two high power sources for metals and oxides (co-deposition capabilities). It is integrated with a double glove box (one dry and one wet with integrated spin-coater) that enables the fabrication and testing of new devices in inert atmosphere. A second glove box is equipped with a microprobe station and a semiconductor parameter analyzer. The facility is fully equipped for the testing of organic light-emitting diodes, organic field-effect transistors, and organic solar cells.

Contact: Bernard Kippelen, Georgia Institute of Technology
kippelen@ece.gatech.edu

See Appendix 4 for a more detailed listing of facilities available within the CMDITR.



Education

Mission

The mission of the education program is to **integrate** the scientific content and practices of CMDITR with **research-based educational strategies** to create a **comprehensive set of linked** educational and partnership programs that enhance and promote scientific and technical literacy and diversity as they relate to information technology.

Goals	Current Initiatives
Teaching Resources: To contribute to innovative science and engineering (S&E) teaching and learning by developing new educational materials based on inter-disciplinary CMDITR research	<ul style="list-style-type: none">▪ Graduate Course Development▪ NSU PhD Program Development▪ Research Experiences for Undergraduates▪ K-12 Web Modules
Outreach: To train a diverse population of students in the S&E career pipeline	<ul style="list-style-type: none">▪ Undergraduate Research Experiences▪ Student / Faculty Exchange Program▪ Mentoring programs for students from under-represented populations
Responsible Conduct of Research (RCR): To incorporate the understanding of RCR practices and intellectual property issues into the educational curriculum of CMDITR S&E students	<ul style="list-style-type: none">▪ RCR Tutorials▪ RCR Discussion Series

Graduate Course Development

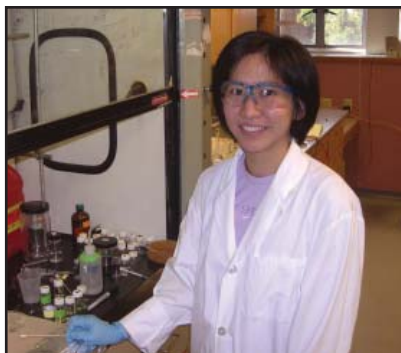
The centerpiece of CMDITR's educational effort, our Graduate Course Development, is in initial development stages. The EPP team and CMDITR faculty are currently working on a series of graduate courses (e.g. OLED Devices, Electro-optic Materials and Self-Assembly) that combine interdisciplinary content and highlight interconnections in a manner that expresses the uniqueness of the Center. Lectures will be combined to create modules covering topics relevant to CMDITR research (e.g. absorption and emission of radiation, electronic structure of conjugated materials). These modules may be used as stand-alone resources or combined in multiple formats to form new courses.

Ultimately, teaching modules will be available by streaming video at CMDITR institutions and stored online. Completion of initial modules is scheduled for delivery in Fall 2005.

Undergraduate Research Experiences (REU)

"Hooked-on-Photonics" is a summer research program based in CMDITR laboratories. It provides Gateway experiences for lower-division undergraduates who are just beginning to explore different academic pathways (typically from community and small liberal arts colleges).

In summer of 2004, the Center funded 22 students. Using a combination of NSF Site Program, CMDITR, and partner university funds, we will place 25 students with STC faculty in 2005. As part of CMDITR's growing partnership with Norfolk State University (NSU), 9 students will participate in a joint 2005 summer program, spending four weeks in NSU labs and an additional five weeks working with CMDITR researchers at Georgia Tech.



On an ongoing basis, the Center has limited funds to support both Gateway and Capstone (upper-level) undergraduates who wish to do research during the school year.

K-12 Web Modules

Web modules developed by the Center are designed as hands-on support materials for teaching of physical science in grades 6-12 (e.g., teachers may use modules to introduce a topic, illustrate an application, or provide opportunities for students to apply their understanding). This program is now supported by the Arizona Board of Regents as part of a professional development opportunity for high school teachers in Tucson, AZ.



Interdisciplinary Workshop

In the summer of 2003, the CMDITR hosted an interdisciplinary workshop sponsored by the Petroleum Research Fund. This workshop provided an intensive educational experience in the area of chemistry of materials and devices for photonics and IT research. Details of the Workshop and videos of speakers are available at www.stc-mditr.org/events/ACS_PRF2003.cfm.

Student / Faculty Exchange Program

Faculty Exchanges offer opportunities for CMDITR faculty to visit minority serving universities (MSU's) to present seminars related to CMDITR research and to meet with faculty and students. Conversely, MSU faculty may access Center funding to visit CMDITR laboratories to plan potential research project partnerships and to meet with faculty and students.

Student Exchanges offer opportunities for undergraduate and masters-level students from MSUs to engage in summer and academic year research experiences in CMDITR laboratories.

Mentoring Programs

The Center is actively developing mentoring programs to help all students (particularly those from underrepresented populations) integrate into the Center, develop work/life balance, and explore career possibilities. Faculty, postdoctoral, and student advisors receive mentorship training to help them prepare for our summer REU programs. The CMDITR mentoring program draws upon well known, award-winning mentoring guidelines, including those established for the Women in Science and Engineering (WISE) program at UW.

Responsible Conduct of Research (RCR)

Web-based tutorials – as required by our Cooperative Agreement with the NSF, the RCR Tutorials provide all Center participants with an initial certification in ethics training. This web-based certification consists of three modules:

1. *Rights and Obligations*
2. *Collaboration, Communication, and Grants Management*
3. *Intellectual Property*



Discussion Series – The RCR Discussion Series is meant to augment the RCR tutorial experience by encouraging members to analyze real-life case studies in groups and to hear presentations by experts. Topics for the 2004-2005 academic year include Authorship, Intellectual Property, Conflict of Interest, and societal impact of technologies that may arise from CMDITR research.

Education Advisory Committee

The Center's education and partnership program is advised by the Education Advisory Committee. Composed of representatives from education, science and industry, the Committee meets periodically to exchange knowledge and ideas related to CMDITR programs and to provide an external perspective to help guide future planning.

Opportunities & Resources

Membership in the CMDITR provides you the opportunity to collaborate on broad, interdisciplinary, highly productive research and educational projects which will have far-reaching impacts on photonics and information technology.

Enhanced Networking

Broadly, the Center is a multi-institutional, interdisciplinary **network** of researchers and professionals. There are a variety of ways that members can take advantage of this network to broaden their research and education horizons. In addition to local seminars hosted at individual Universities, the Center hosts an annual **CMDITR Retreat** to review research progress and brainstorm about opportunities to advance the state of our science. The Center also hosts an annual **Industrial Affiliates EXPO** where our members get the chance to meet industry contacts, network, and showcase their research. Networking opportunities are further promoted through the **Student and Faculty Exchange Programs, Interdisciplinary Workshops, CMDITR Social Events**, and postdoctoral and graduate student **Travel Grants** (see below). Members also stay connected through the quarterly newsletter, **Light Works** which features current research, education, and membership updates.

State of the Art Research Facilities

State of the art research facilities are crucial to the mission of the Center and constitute an important benefit to all members.

Our facilities currently include a **Network Linux Cluster** consisting of 40-processors, a **Hyper-Rayleigh Scattering (HRS) Facility**, a **Synthetic Scale up and Purification Facility**, and an **Organic Electronics Facility**.



The Travel Grant program is designed to allow graduate students and post doctorates to expedite their research by utilizing facilities across all Center campuses.

Communication Technologies

To facilitate collaboration and communication, the Center maintains video-conferencing equipment UW, UA, GT, NSU, and NMHU, and additional ViaVideo stations are available for new PIs and other interested parties. This equipment is used for management team meetings, distance learning, and research collaboration. All members are encouraged to explore ways to utilize this technology to enhance their collaborations within the Center. Contact an administrator at any of the above mentioned Universities for additional information.

Undergraduate Research Program (REU)



The Undergraduate Research Program, which integrates the education and research sectors of the Center, benefits the membership in multiple ways: **faculty** gain the opportunity to cultivate potential graduate students; **graduate students** and **postdoctoral associates** receive access to mentorship training; and, in addition to the actual research experience, **undergraduates** learn concrete professional skills through workshops and seminars.

Intellectual Property (IP) Expertise

The Center helps facilitate proper IP management by providing center-wide mechanisms to make sure the valuable discoveries made by participating investigators are properly disclosed and protected prior to being shared publicly. In our changing climate of decreased federal funding and increased demand that funded research have positive societal and economic impact, development of IP and commercializable technologies will play an increasingly large role in funding decisions. Researchers that understand the role of IP are likely to have a competitive edge. In addition to Center oversight, every major university has an Office of Technology Transfer that can help guide researchers through the patenting process.

Mentoring of Junior Faculty

During its third year of funding, the Center underwent a major reorganization, placing emphasis on increased participation by faculty from underrepresented groups. Among those recruited were a number of junior faculty. The Center provides mechanisms of collaboration and networking that allow new faculty to greatly expand their field of experience and increase their likelihood of success. Junior faculty, postdoctoral fellows and students represent the future of both the Center and US Science and Engineering in general.

Website and Document Archive

The Center maintains a comprehensive website and database system. In addition to informing the general public of our activities and accomplishments, the website is intended as a primary communications conduit for all members. To this end, a sophisticated database has been developed to provide a detailed directory, a place to report products (e.g. publications, conference presentations, patents, etc.), a meeting registration resource, and an archive of documents, presentations, photos, and graphics for all members.

Update your profile by visiting the CMDITR website at www.stc-mditr.org and following the "Login" link

For Graduate Students and Postdocs

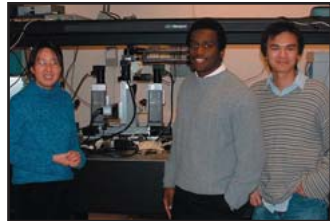
The Center has implemented several unique initiatives to facilitate research and provide networking and career resources to its postdoctoral and graduate student members.

Enhanced Scientific Education

The CMDITR's **Education Program** has many opportunities for graduate students. The Graduate Course currently in development will highlight broad research interconnections by creating interdisciplinary teaching resources not available in traditional discipline-specific graduate coursework. Students will be invited to critique new lecture modules and contribute to the development of this versatile curriculum. Other educational opportunities include **Interdisciplinary Workshops**, and **Responsible Conduct of Research Seminars**.

Travel Grants

In order to facilitate collaboration and networking, **Travel Grants** are available to graduate students and postdoctoral associates wishing to go from one partner institution to another for CMDITR research or education purposes. These grants pay for travel and subsistence up to \$1,000. For more information and to apply, go to www.stc-mditr.org/getinvolved/travel_grant.cfm.



Fellowship Program

To increase the diversity of the leadership pipeline in Science and Engineering, the Center has created a **Fellowship Program** for graduate students and postdocs from underrepresented groups. This program addresses three needs:

1. Sustaining underrepresented students and postdocs of PIs whose Center funding is in transition
2. Recruiting students and postdocs from underrepresented groups beyond those supported by standard Center awards to PIs
3. Sponsoring at least one GEM-CMDITR Fellowship each year using funds internal to the Center

Candidates who are working on Center-related research, who are US Citizens or Permanent Residents, and who are nominated by their advisors may apply at www.stc-mditr.org/careers/fellowship.cfm. Awards may begin at any time in the fiscal year but can only be guaranteed through the end of the current fiscal year (July 31). Full-year fellowship requests must be received by June 30. Funding for this program is limited and will depend on available resources.

Web-based Resume Bank

The CMDITR website hosts a student resume bank to help connect participating students with prospective employers. Student resumes are first made available to our industrial affiliates (exclusive 30-day preview window), then made accessible via our public website to reach a broader audience of potential employers. Students may visit our “Members-Only” website to view some brief guidelines and upload their personal resume as a pdf file. **Log on by visiting www.stc-mditr.org and following the “Login” link.** To protect student privacy, a signed release form is required before their information can be shared publicly, and companies must register prior to accessing the resume bank.

Funded Travel to the Center’s Annual Retreat

Each year the CMDITR funds travel for one student or postdoctoral fellow per funded PI to attend the Center’s annual retreat. The retreat provides an excellent opportunity for students to share research findings, build new collaborations, provide feedback and insights into Center operations, and meet with Industrial Affiliates. Students must be recommended by their advisor, and have completed the online RCR modules in order to receive funded travel.

Seminar Series

Each of the principal partner campuses hosts regular seminars convened by Center leaders. For example at the University of Washington Alvin Kwiram facilitates a monthly photonics colloquium that engages faculty campus-wide. At Georgia Tech, COPE also maintains an active seminar schedule. Students and postdocs are encouraged to attend these seminars and where possible, present their findings before faculty and peers as part of their professional training.

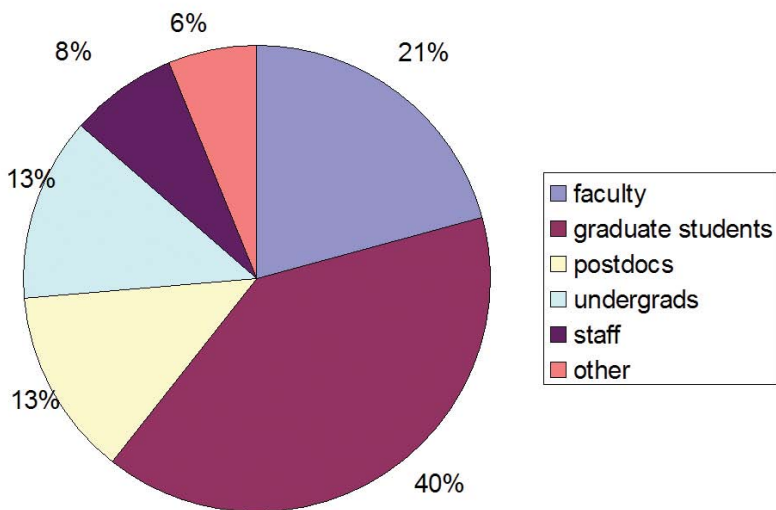


On the Horizon

At the 2005 Annual Retreat, 75 graduate students and postdocs convened, and recommended the formation of a CMDITR Graduate Student and Postdoctoral Advisory Council (GPAC). They also discussed many ideas to increase their participation and improve benefits to all members. Among the ideas currently being discussed for future implementing are:

- Participation in the development of graduate courses (evaluation, trial lectures, student lectures to teach Center vocabulary)
- Practical mini-courses (proposal writing, poster prep, job search, etc.)
- Other online resources
 - Online question and answer forum
 - More presentations uploaded to website (including student/PD talks for self-evaluation)
 - CMDITR alumni listing and industry contacts for career search
 - Inter-institutional course lecture notes online
 - Seminal publication lists
 - Online posters
 - Photo gallery (with captions/names)
 - Dissertation archive
 - Professional Society conference schedule.

CMDITR Participants in Year-3



Membership Information & Policies

Membership in the CMDITR is accorded to all institutions and organizations which have a formal contractual or collaborative relationship with the Center.

Institutional membership can take the form of a **partnership** or an **associate membership**. CMDITR Partner Institutions are those identified in the Cooperative agreement as well as any other institutions with a contractual relationship to the Center. Associated Institutions are those engaged in formal projects or collaborations with the Center (for over 160 hours per 12 month period) but not contractually bound.

Individual membership can take the form of **Participant** or **Affiliate**.

- **Participant** – an individual who spends 160 hours or more over a 12 month period at the Center. CMDITR currently has over 200 faculty, staff, and students who are active participants. Approximately one-half of these participants receive funding or salary support as a result of their membership.
- **Affiliate** – an individual associated with the Center who does not meet the 160 hour requirement for Center participants. CMDITR currently lists approximately 100 active affiliates.

Individual members include faculty, visiting faculty/scientists, postdocs, graduate students, undergraduates, and staff at contractually associated institutions. “External” members (also defined as participant or affiliate) are individuals who devote time to CMDITR research, education, or knowledge transfer activities, but have no contractual relationship to the Center.

For more information on membership, please log in to the CMDITR website (www.stc-mditr.org) and check the document archive for the official “Definition of MDITR Membership.”

Responsibilities

STCs are unique among NSF initiatives both in the breadth of research expected and the customary award size. Large awards, lengthened funding periods, extensive partner networks, and shared instrumentation facilities enable research to be accomplished on a very large scale. As a result, NSF's standards exceed those expected of grants awarded to individuals. In addition to developing balanced research and education programs that transcend individual institutional capabilities, the Center is obligated to increase the participation of women and underrepresented minorities into its activities and the broader field of photonics. The hope is that each Center will create lasting legacies that endure long after NSF funding has expired.

To meet (and exceed) NSF's requirements and collaborate effectively across multiple institutions and disciplines, CMDITR needs a high-level of commitment from its membership.

"Members Only" Internal Database

All members of the CMDITR should log-in to their account at the "Members Only" website regularly to report Center related activities. To access this internal website, go to: www.stc-mditr.org and click "Login".

Information maintained within this secure site is crucial to providing accurate information to NSF for annual reporting and periodic updates. This site contains detailed information about research, outreach activities, and demographics for each Center member. Maintaining current and accurate information is necessary for the CMDITR to maintain its funding. Members departing from the Center (e.g. graduates, REU students, postdocs completing their fellowships) should be sure to 'check-out' from the database. The Center's success is heavily dependent on your success, so please log-in and update your information regularly.

Responsible Conduct of Research (RCR) Certification

The CMDITR has established a program of ethics training and certification for all members, including faculty, visiting faculty, staff, industrial fellows, postdoctoral researchers, as well as graduate and undergraduate students. Topics include the nature of research, methodologies used, ownership of research ideas, and roles and responsibilities regarding intellectual property. This is an NSF funding requirement for all 2002 generation STCs. **All members are required to participate in the ongoing RCR activities and programs.**

CMDITR Principal Investigators are expected to:

- 1) Contribute collaboratively to the goals set out by the CMDITR Director and Thrust Leaders to advance the overall research mission of the center
- 2) Actively report activities and accomplishments of interest to the Center database (and directly to NSF where feasible)
- 3) Assess their research group membership and ascertain which students, postdocs, and staff are appropriate to add to the CMDITR roster. PIs should ensure that all Center members from their groups properly register in the database and complete their member profiles as accurately as possible
- 4) Attend the annual CMDITR Retreat, and if requested, ancillary meetings such as the annual NSF Site Visit and Industrial Affiliates Expo
- 5) Support CMDITR's broader mission by assisting in education projects, being supportive of ongoing Center activities such as Responsible Conduct of Research training, and student exchanges between partner universities, as well as taking diversity into consideration in relation to many activities including assignment of CMDITR funding and recruitment of new students, postdocs, and faculty.

A comprehensive list of expectations of CMDITR Principal Investigators can be found by logging into the CMDITR website (www.stc-mditr.org) and looking in the document archive.

CMDITR awards to PIs are one-year commitments, generally allocated to fund at least one full-time graduate student. Continuation of CMDITR funding to PIs is contingent upon:

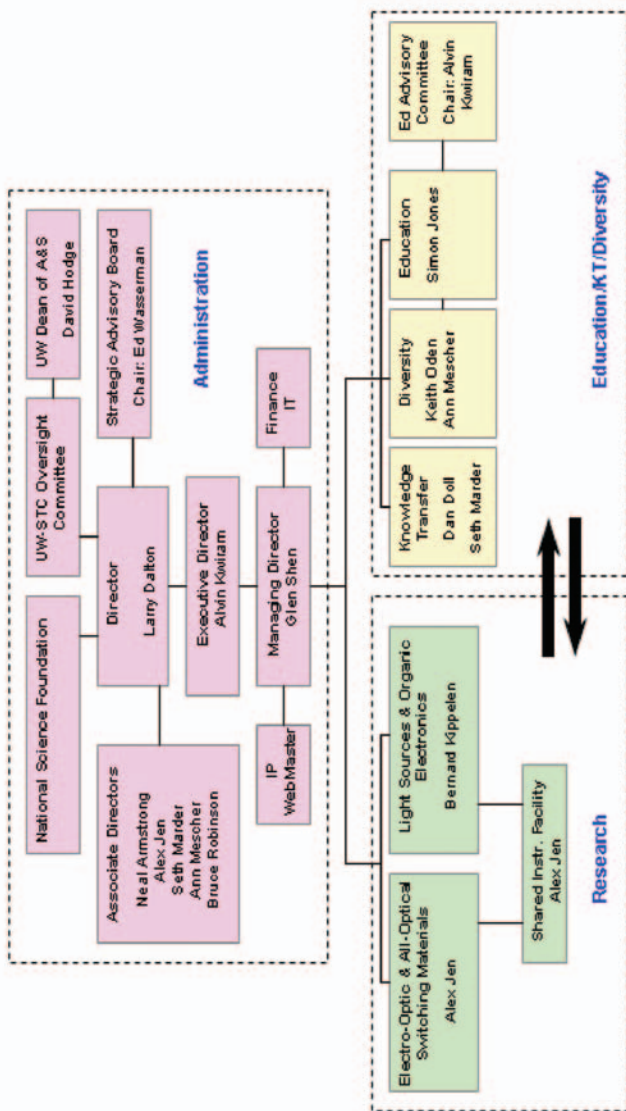
1. Satisfactory performance
2. Continued fit between the PI's research expertise and the Center's technical mission
3. Availability of funds



Photo and Editorial Credits:

Cecile Domercq, Maggie Harden, Suzy Hunter, Simon Jones, Nira Kumaran, Matthew A. Lynn, Dan Patel, Glen Shen, Darcy Van Patten

Appendix 1: Organizational Chart



Researchers Organized by Thrust:

EO-AOS Thrust	LSOE Thrust
Thrust Leader: Alex Jen (UW)	Thrust Leader: Bernard Kippelen (GT)
Larry Dalton (UW)	Sue Ann Bidstrup Allen (GT)
Bruce Robinson (UW)	Neal Armstrong (UA)
John Rehr (UW)	Dominic McGrath (UA)
Phil Reid (UW)	Samson Jenekhe (UW)
Bart Kahr (UW)	
Nasser Peyghambarian (UA)	
Mahmoud Fallahi (UA)	
Joseph Perry (GT)	
Michael Hayden (UMBC)	
New faculty:	New faculty:
Peter Delfyett (UCF)	Carl Bonner (NSU)
Anthony Johnson (UMBC)	Scott Saavedra* (UA)
Lih Lin (UW)	Samuel Graham* (GT)
Antao Chen* (UW)	Elisa Riedo* (GT)
Glenn Bartholomew* (UW)	David Ginger* (UW)
EO-AOS + LSOE Thrusts	
Seth Marder (GT)	
Jean-Luc Bredas (GT)	
Ann Mescher (UW)	
Scott Dunham (UW)	
Axel Scherer (CIT)	
Michal Lipson (Cornell)	

Appendix 2: Faculty Descriptions

Electro-Optic & All-Optical Switching Thrust Leader: Alex Jen, University of Washington

Glenn Bartholomew — University of Washington



(Chemistry) Rational design of materials with structures and electronic properties conducive for a number of photonic and electronic applications. Current efforts in three areas: 1) sugar-derivatized electronic organic chromophores, 2) chemistry to induce “permanent” charge distributions in organic electronic and/or light emitting devices and 3) new materials and strategies for photovoltaics.

Antao Chen — University of Washington



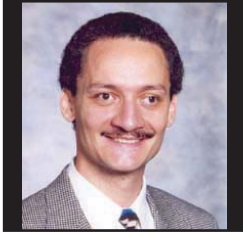
(Applied Physics, Electrical Engineering) Nonlinear optical polymer materials and optical waveguide devices, fiber optic devices for telecommunication and radio-frequency applications, optical sensors for bio- and chemical detection, and nanometer scale photonic structures.

Larry Dalton — University of Washington



(Chemistry, Electrical Engineering) Materials chemistry with particular emphasis on high technology electronic, electro-optic, and nonlinear optical materials. Emphasis on nanoscale materials and architectural construction techniques.

Peter Delfyett — University of Central Florida



(Optics, Electrical & Computer Engineering, Physics) Laser system development and optoelectronics. Short pulse semiconductor laser development, external cavity semiconductor laser devices and devices for optical networks. High data rate photonic networks through techniques for optical clock distribution, multi-wavelength source synchronization, and all-optical clock recovery.

Mahmoud Fallahi — University of Arizona



(Optical Sciences) High power semiconductor lasers, DFB/DBR lasers, grating-assisted integrated optics, photonic integrated circuits, optical communication, wavelength multiplexers and demultiplexers, wavelength filters, solgel-semiconductor integration, WDM components, sensors, design and microfabrication, nanofabrication and nanostructures, solgel PIC.

Michael Hayden — University of Maryland Baltimore County



(Physics) Development and characterization of efficient, wide-band emitter-detector pairs of electro-optic polymer composites useful for the generation and detection of THz radiation. Exploration of new terahertz technologies. Atomistic molecular modeling of electric field poling and far-IR absorption in electro-optic polymers.

Alex Jen — University of Washington



(Materials Science & Engineering; EO-AOS Thrust Leader) Development of new organic synthetic methodologies of making highly efficient, processible, and thermally stable chromophores and polymers for nonlinear optical, light-emitting (electroluminescence, lasing), and imaging/microfab (two-photon absorption) applications. Device fabrication.

Anthony Johnson — University of Maryland Baltimore County



(Physics, Computer Science, Electrical Engineering) Ultrafast photophysics and nonlinear optical properties of bulk, nanostructured, and quantum well semiconductor structures, ultrashort pulse propagation in fibers and high-speed lightwave systems.

Bart Kahr — University of Washington



(Chemistry) Understanding the growth, structure, and physical properties of organized media including new crystalline materials and ordered biological structures, as evidenced by their interactions with polarized light.

Lih Lin — University of Washington



(Electrical Engineering) Nano-scale photonic devices and integrated systems, bio-photonics, micro-instrumentation by optical MEMS, self-assembled systems, and nanomaterials.

Nasser Peyghambarian — University of Arizona



(Optical Sciences) Femtosecond laser spectroscopy and dynamics of optical phenomena in semiconductors and organic materials. Fiber lasers, fiber amplifiers and fiber optics components. Nonlinear photonics and high speed optical switching. Characterization of optical materials. Polymer optoelectronics, photorefractive polymers, organic light emitting diodes and lasers.

Joseph Perry — Georgia Institute of Technology



(Chemistry & Biochemistry) Molecular nonlinear optical properties; laser spectroscopy; two-photon and multi-photon absorption; nonlinear photoactive materials for 3D patterning; 3D micro-and nano-fabrication, and two-photon fluorescence probes for biological imaging and sensing.

John Rehr — University of Washington



(Physics) Development of multiple scattering calculations for interpreting the X-ray Absorption Fine Structure (EXAFS) and X-ray Absorption Near-Edge Structure (XANES) spectra for clusters of atoms.

Phil Reid — University of Washington



(Chemistry) Linear and non-linear microscopy of non-linear optical materials. Development of novel optical materials for telecommunications and information processing, using a variety of spectroscopic techniques to characterize non-linear optical materials.

Bruce Robinson — University of Washington



(Chemistry) Theoretical calculations of non-linear optical materials. Use of Electron Paramagnetic Resonance (EPR) techniques, including continuous wave and pulsed Saturation Recovery (pSR) and pulsed Electron-Electron Double Resonance (pELDOR) EPR.

Light Sources & Organic Electronics

Thrust Leader: Bernard Kippelen, Georgia Institute of Technology

Neal Armstrong — University of Arizona



(Chemistry & Optical Sciences) Development and nanometer-scale characterization of new self-organizing molecular assemblies, characterization and chemical modification of interfaces in emerging organic electroluminescent and organic photovoltaic technologies, new chemical sensor platforms based on combinations of electrochemistry, micro-contact printing, polymer thin films, and optical waveguide technologies.

Sue Ann Bidstrup Allen — Georgia Institute of Technology



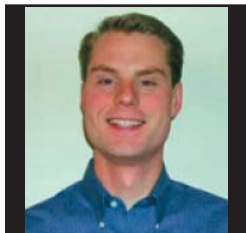
(Chemical and Biomolecular Engineering) Polymeric systems and processing conditions used in electronic packaging. Development of in-situ sensors and characterization techniques to evaluate properties of thin polymeric films for GHz multichip modules. Exploration of the effect of film anisotropy on moisture diffusion, modulus, coefficient of thermal expansion, and conductivity.

Carl Bonner — Norfolk State University



(Chemistry) Hetero-epitaxy of single crystal organic materials with nonlinear optical properties on silicon. Design and characterization of the molecular and macroscopic second hyperpolarizability based properties, two-photon absorption, and nonlinear refractive index in a range of substituted thiacyanine dyes.

David Ginger — University of Washington



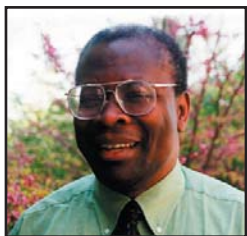
(Chemistry) Interplay between the organizational structure, the electrical properties, and the optical properties of nanoscale materials. Three current projects: (1) the impact of morphology on charge separation and recombination in organic semiconductors (2) charge-exciton coupling in semiconductor quantum dots; and (3) nanoscale plasmon optics.

Sam Graham — Georgia Institute of Technology



(Mechanical Engineering) Properties of thin-films used to create MEMS and nanotechnology devices, concentrating on the growth of thin films and characterization of their thermal transport properties and reliability. Focus on polycrystalline thin-films as well as ceramic and electrodeposited materials for MEMS devices and fuel cells.

Sam Jenekhe — University of Washington



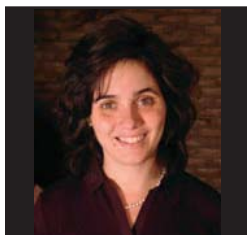
(Chemical Engineering & Chemistry) Understanding the influence of electronic, molecular, and supramolecular structures and morphology of conjugated polymers on their photoconductivity, luminescence, and charge transport properties. The study of synthetic self-assembling nanostructures and microstructures of well defined size, shape, and function.

Bernard Kippelen — Georgia Institute of Technology



(Electrical & Computer Engineering; LSOE Thrust Leader) Organic light-emitting devices for displays and lighting; flexible organic photovoltaic cells for power generation; low-cost organic electronics for RFID; real-time holography and signal processing; ultra-fast photonics; and, structure-property relationships in photonic and electronic material.

Michal Lipson — Cornell



(Electrical and Computer Engineering) Physics and application of nanoscale photonic structures. Light confining structures that enhance light-matter interaction, enabling the devices' optical properties to be controlled optically or electro-optically. Development of building blocks for an all-optical circuit where passive and active components are integrated on a single chip.

Dominic McGrath — University of Arizona



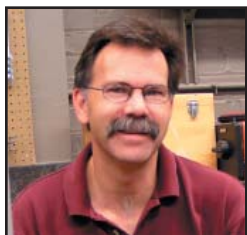
(Chemistry) Use of organic synthesis for the design, development, and application of new concepts in macromolecular, supramolecular, and materials chemistry. Synthesis of well-defined molecular architectures for nanometer scale technologies including light-emitting diodes and photovoltaics.

Elisa Riedo — Georgia Institute of Technology



(Physics) UHV surface science characterization (STM, LEED, TDS) of metal and metal oxides surfaces, thin film surfaces, and nanostructures ; experimental nanomechanics and nanotribology with atomic force microscopes (friction, adhesion, elasticity, wear); amorphous carbon thin films

Scott Saavedra — University of Arizona



(Chemistry) Multidisciplinary research activities organized around several overlapping themes: the chemistry of bio-interfaces and analytical techniques appropriate to study them, new molecular assemblies for molecular device technologies such as chemical sensing and energy storage/transduction, and development of molecular devices based on optical waveguide transducers.

Faculty that Span Both Thrusts (EO-AOS and LSOE)

Jean-Luc Bredas — Georgia Institute of Technology



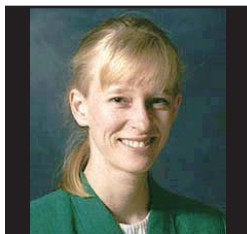
(Chemistry & Biochemistry) Theoretical investigations based on computational techniques to investigate 1) electronic properties of conjugated polymer, oligomer, or molecular materials; 2) new oligomer or polymer structures leading to enhanced 2nd/3rd order NLO properties; 3) electronic structure of organic/metal interfaces; 4) mechanisms for charge/energy transport in conjugated organic materials

Scott Dunham — University of Washington



(Electrical Engineering) Modeling of integrated circuit fabrication processes, with emphasis on interactions involving point and extended defects; computational materials, focused on study of the atomistic basis of solid-state diffusion and aggregation processes; modeling of semiconductor device behavior; modeling of fabrication and operation of microstructures.

Ann Mescher — University of Washington



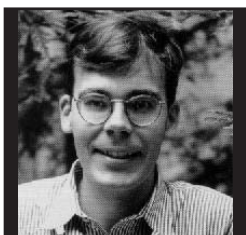
(Mechanical Engineering) Fabrication of photonic bandgap polymer fiber and polymer fiber with third order harmonic generator. Integration of thermal-fluids sciences and materials processing, with emphasis on the relation between the material properties of a manufactured product and its processing conditions.

Seth Marder— Georgia Institute of Technology



(Chemistry & Biochemistry) Development of materials for nonlinear optics, applications of organic dyes for photonic, display, electronic, and medical applications, and organometallic chemistry. Understanding how the chemical structures of molecules and materials relate to their electronic and optical properties, and how to control the interactions of light and matter.

Axel Scherer — California Institute of Technology



(Electrical Engineering, Applied Physics, Physics) Device fabrication based on nanostructures for new optoelectronic, magneto-optic and high-speed electronic applications. Vertical cavity surface emitting lasers, microfabrication of photonic bandgap crystals, high resolution lithography with anisotropic transfer of mask patterns to produce 6 nm size features.

Appendix 4: Facilities & Equipment

University of Washington		
Item Make/Model	Contact Person Location	Details
3-axis micro-positioner Aerotech/U511R-A-40	Jen Wilcox 230	Micro-position aligner to test optical waveguides
40 Processor Cluster Computer 40 node Network Computer 1.6GHz Athlon processors. 1Gig SDRAM, 40 Gbytes Hard Drive for each node.	Robinson Bagley 110	Available to STC members via remote connections; has Gaussian and other such packages.
Confocal Microscope Nikon Inverted with APD detectors and excitation at 488 and 532 nm	Reid CHB G013	Used for single-molecule microscopy studies of non-linear optical materials.
Contact aligner AB-M	Jen Fluke Hall 135	Wafer size: 4-inch wafer
Diode Lasers LaserMax, Inc.	Jen Roberts 209	633 nm, 1300 nm and 1550nm
EPR Spectrometers (2) Bruker EMX and SR TD EPR	Robinson Bagley 110	
Hyper-Rayleigh Spectrometer Spectra Physics Opal System with spectrograph and CCD	Reid CHB G013	Used for characterization of molecular hyperpolarizability from 0.7 to 1.9 microns. Other laser systems are also available for HRS measurements.
Impedance Analyzer HP 4192A LF	Jen Roberts 209	5 Hz to 13 MHz Freq range, automated data collection
Laser diode with optical fiber HP/E5974A	Jen Wilcox 230	1310 and 1550 nm wavelength laser
Lightwave multimeter HP/8153A, 81533B	Jen Wilcox 230	Optical detector (900-1700nm)

University of Washington		
Item Make/Model	Contact Person Location	Details
OLED characterization system HP4155B semiconductor parameter analyzer for IV; Newport multifunction optical meter and calibrated detectors; InstaSpec IV CCD spectrometer; PR-650 chromatometer for CIE coordinates; Integrating sphere for absolute PL efficiency	Jen Wilcox 232	Si-detector for UV-vis light power and efficiency measurement; InGaAs-detector for near infrared
Optical microscope Leica/M420	Jen Wilcox 230	
Optical Microscope Olympus	Jen Roberts 209	Not digital
OPV characterization system HP4155B semiconductor parameter analyzer; Oriel solar simulator	Jen Wilcox 232	AM1.5 and AM1.0 conditions
Organic electronics fabrication system VAC-Nexus One Ar-Protected Glovebox; Cook Vacuum multi-source evaporator; Denton Vacuum evaporator; Solitec programmable spin-coater; KW-4A spin-coater in glovebox; SPI plasma prep II	Jen Robert 209	OLED and OPV fabrication
Oscilloscope Tektronics/TDS684C	Jen Wilcox 230	1GHz, 5GS/s
Prism Coupler Metricon 2010 Prism Coupler	Jen Roberts 209	Measures refractive index, film thickness, and optical loss at 633 nm, 830 nm, 1300 nm and 1550nm
Reactive ion etcher Phantom RIE	Jen Fluke Hall 135	Process gases (SF ₆ , CHF ₃ , O ₂) and substrates (silicon, glass, quartz, polymer)
Spin Coater Solitec	Jen Roberts 209	

University of Washington		
Item Make/Model	Contact Person Location	Details
Sputter Coater Denton Vacuum Desk II	Jen Roberts 209	Typically use Au targets
Surface profilometer Tencor/Alpha step 200	Jen Fluke Hall 135	Resolution: 50 A. Scan length: 3mm, 2.5mm
Teng Mann Technique (r33) SRS 850 Lock-in Amplifier, Tecktronix TDS520 Oscilloscope, Trek 610C Voltage Amplifier, SRS DS345 Function Generator	Jen Roberts 209	Everything under computer control
Thickness Measurement Dektak 3030, Veeco Instruments	Jen Wilcox 230	Measures thin films. 1 nm resolution
TOF test system VSL-337 Nitrogen pulse Laser; Agilent 8114A - 100V 2A programmable pulse generator; Tektronix TDS684C 1GMHz digital storage oscilloscope; Stanford Research PS350 power supply (5000V, 25W)	Jen Wilcox 230	337.1nm. 4ns
UV Spectrophotometer Perkin Elmer Lambda 9 UV/VIS/NIR	Jen Roberts 209	Measures the absorption and transmission from the UV to the NIR
Vidicon Hamamatu/c2741	Jen Wilcox 230	IR camera

University of Arizona		
Item Make/Model	Contact Person Location	Details
5 UHV deposition chambers Custom	Armstrong Chemistry	
Argon Ion Laser coupled to a UHV deposition system ILT 5500ASL	Armstrong Chemistry	
CCD based Spectrofluorimeter ISA Triax Series III, 190	Armstrong Chemistry	

University of Arizona

Item Make/Model	Contact Person Location	Details
Fiber Drawing Tower Heathway	Peyghambarian Optical Sciences	Built 2001. Allows for drawing of specialty optical fibers from glass preforms; designed to work with soft glasses (telluride, phosphate, pyrex, etc.); max. temp. is 1100 degrees C; pulling speed can be varied between 0.1 m/min and 20 m/min.; allows for automatic pulling- the machine controls the specified size of the fiber
Fiber optic/CCD UV-vis spectrometer Spectral Instruments	Armstrong Chemistry	
Infrared spectrometer Nicolet 550 Series II FT-IR	Armstrong Chemistry	with polarizer and reflectance capabilities
Ion Beam optical coating system Veeco's SPECTOR	Peyghambarian Optical Sciences	Accommodates either planetary, simple rotation, or flip fixtures within an interchangeable platform.
Langmuir-Blodgett Trough R&K #RK3	Armstrong Chemistry	
Mask Aligner Suss MJB3	Peyghambarian Optical Sciences	Equipped with UV 400 optics.
Potentiostat Cypress Systems 2Ra	Armstrong Chemistry	
Potentiostat EG&G 283	Armstrong Chemistry	
Prism Coupler Model 2010	Peyghambarian Optical Sciences	Measures the thickness and the refractive index/birefringence of dielectric and polymer films at 633, 830, 1300 and 1550 nm.
Profiler Alpha - Step 500	Peyghambarian Optical Sciences	Measures micro-roughness with up to 1A resolution over short distances and waviness over a full 10-mm scan.

University of Arizona		
Item Make/Model	Contact Person Location	Details
Reactive ion etcher Oxford Plasmalab 100	Peyghambarian Optical Sciences	has six gas input lines (argon, oxygen, hydrogen, methane, helium, freon and chlorine). Loadlock is designed for 8" wafers.
Spectrophotometer Cary 500 UV-Vis-NIR	Peyghambarian Optical Sciences	Double beam, double grating SPM with a 0.175<<3,300 nm range.
Sputter/Etching System Oxford Ionfab 300Plus RF	Peyghambarian Optical Sciences	Ion sources are 3 cm (for sputtering) and 15 cm (for etching) in diameter; designed for 6" wafers;four different targets can be used.
UHV deposition chamber coupled to a Vacuum Atmosphere glove box N/A Custom	Armstrong Chemistry	

Georgia Institute of Technology		
Item Make/Model	Contact Person Location	Details
1, 5 and 6-axis micro-positioners Luminous Industries	Kippelen Bunger-Henry 328A (Imaging and Ultra-fast Optical Processing)	10 nm resolution
Bench-top spin coater Laurell Technologies	Kippelen Bunger-Henry 269 (Organic Thin Film Deposition)	External to glove boxes
Clean room facilities	MIRC	
e-beam high vacuum deposition system. Kurt J. Lesker 'Axxis'	Kippelen Van-Leer 424: Inorganic Thin Film Deposition	computer controlled; water cooled substrate platform for deposition of materials onto flexible plastic substrates.
fiber cleaver and fusion splicer EFC11/4 and Ericsson FSU-995FA	Kippelen Bunger-Henry 328A (Imaging and Ultra-fast Optical Processing)	

Georgia Institute of Technology

Item Make/Model	Contact Person Location	Details
four-wave-mixing optical set-up Stanford Research Systems SRS830 optical chopper/lock-in amplifier (lock-in under computer control). Keithley 6517A electrometer with fA resolution to measure light and dark conductivities of photorefractive materials	Kippelen Bunger-Henry 328A (Imaging and Ultra-fast Optical Processing)	
High vacuum zone purification system Lindberg/Blue-M three-zone tube furnace; BOC Edwards scroll; turbo pumps	Kippelen Bunger-Henry 213 (Organic Purification/Processing)	Can achieve 10-6 torr
Microprobe station Lucas-Signatone H100 in MBraun Labmaster 130 nitrogen glove-box; Agilent E5272A 2-channel source-monitor unit; Agilent 4284A precision LCR meter	Kippelen Bunger-Henry 244 (Organic Electronics and Photovoltaics)	± 100VDC range, 200 mA current limit; LCR: 20 Hz to 1 MHz; All measurements automated using LabVIEW.
optical chopper/lock-in amplifier Stanford Research Systems SRS830	Kippelen Bunger-Henry 328A (Imaging and Ultra-fast Optical Processing)	lock-in under computer control
optical parametric oscillator, source, and lasers Spectra-Physics 'OPAL' (1350 nm < ? < 1600 nm); Ando AQ4321D tunable source (C and L bands), 1 mW fiber-coupled DFB laser at 1550 nm; ILX lightwave LDC-3724B laser diode; TEC driver unit for various semiconductor lasers including 980 nm pump lasers for Erbium based compounds.	Kippelen Bunger-Henry 328A (Imaging and Ultra-fast Optical Processing)	pulses of <130 fs at 83 MHz and > 150 mW average power. Resources for the characterization and manipulation of ultra-fast pulses include an auto-correlator and a computer controlled delay line.

Georgia Institute of Technology

Item Make/Model	Contact Person Location	Details
Optical polarizing microscope Olympus BX51; Instec temperature controlled hot stage (to 200°C)	Kippelen Bunger-Henry 244 (Organic Electronics and Photovoltaics)	transmitted and reflected light @ max. magnification of 50X; digital image capture/ analysis capabilities
optical spectrum analyzer Agilent 86140B	Kippelen Bunger-Henry 328A (Imaging and Ultra-fast Optical Processing)	10-pm accuracy and 30 dBm power capacity from 300 nm to 1700 nm (also under computer control).
Physical vapor deposition system and characterization of OLEDs and OPV devices Kurt J. Lesker 'Spectros'; access via MBraun Labmaster nitrogen double glove-box. Box 1: Keithley 2400 sourcemeter (for I-V); calibrated Si detector and data acquisition board (for luminance). Box 2: solvent vapor removal system for integrated Headway Research spin coater.	Kippelen Bunger-Henry 269 (Organic Thin Film Deposition)	4 organic/2 metal evaporation sources; computer control for run-to-run repeat-ability; can carry out co-depositions of 2 materials.
Solar simulator Oriental Xenon	Kippelen Bunger-Henry 269 (Organic Thin Film Deposition)	to test OPV devices under AM1.5 conditions
Space charge limited current (SCLC) I-V measurement Keithley 2400 sourcemeter	Kippelen Bunger-Henry 328A (Imaging and Ultra-fast Optical Processing)	automated data collection using LabVIEW
stereo zoom microscope Olympus SZ60	Kippelen Bunger-Henry 328A (Imaging and Ultra-fast Optical Processing)	90X maximum magnification
Time-of-flight transients 500 MHz Agilent 'Infinium' digital storage oscilloscope; Laser Science, Inc. nitrogen laser optical source	Kippelen Bunger-Henry 328A (Imaging and Ultra-fast Optical Processing)	< 4 ns pulses of > 300 μ J at 337 nm; temperature controlled sample mount to + 200°C and accurate to \pm 0.1°C.

Other Nearby User Facilities	Location	Website/Contact
Center for Nanotechnology User Facility	University of Washington Fluke Hall 117	www.nano.washington.edu
WA Technology Center Microfab Lab	University of Washington Fluke Hall 135	www.watechcenter.org
Georgia Tech Microelectronics Research Center	Georgia Tech 791 Atlantic Dr.	www.mirc.gatech.edu
Electron Paramagnetic Resonance (EPR)	University of Arizona Chemistry	http://quiz2.chem.arizona.edu/epr/
Laboratory for Electron Spectroscopy and Surface Analysis (LESSA)	University of Arizona Gould Simpson	www.chem.arizona.edu/facilities/lessa/lessa_main.html
Mass Spectrometry Facility (MSF)	University of Arizona Chemistry	www.chem.arizona.edu/facilities/msf/index.html
Molecular Structure Laboratory (MSL)	University of Arizona Chemistry	www.chem.arizona.edu/facilities/msl/mslindex.html
Nuclear Magnetic Resonance (NMR)	University of Arizona Chemistry	www.chem.arizona.edu/facilities/nmr/nmrindex.html
Photoelectron Spectroscopy (PES)	University of Arizona Gould Simpson	www.pes.arizona.edu/facility/
Microfabrication Facility (Glass fabrication, polishing, dicing and machining; Ion Exchange Waveguide Fabrication; Optical Test Facilities)	University of Arizona Optical Sciences	Nasser Peyghambarian/ Olli Nordman