Light Works

Reflect on it...

A bi-monthly newsletter for the NSF Science and Technology Center on Materials and Devices for Information Technology Research

January/February 2005

CMDITR Annual Retreat Feb 9-10

Our Annual Retreat, to be hosted at Georgia Tech's Student Success Center, is just around the corner. If you haven't registered online yet, please logon and plan to join us.

This year's Retreat has several objectives:

1. To discuss our research progress and redirect efforts along two primary thrusts to be led by Alex Jen (EO-AOS) and Bernard Kippelen (LSOE)
2. To more actively engage our graduate students and postdoctoral researchers
3. To welcome numerous new members to the Center
4. To discuss and enlist support for CMDITR's educational goals
5. To strengthen CMDITR's sense of community.

To help meet these objectives, the planning committee has assembled a two-day agenda that includes oral and poster presentations by at least one student or postdoc from every funded research group, short talks by new PIs, Center-wide dining events, a session devoted to CMDITR educational activities, and a working lunch where students and faculty will separately brainstorm ideas for improving Center programs and participation. To encourage attendance, the Center is paying full travel costs for students and postdocs selected for presentations (max. 1 per research group) and absorbing hotel (Holiday Inn Express) and group dining costs for all attendees.

If you only attend one STC event this year, please make it the Retreat. We look forward to seeing you in Atlanta!

Industrial Affiliates Program (IAP) Expo – Feb 11

Our Center currently has six corporate affiliates with whom we meet at least annually to mutually share technical, educational, and diversity enhancement progress. These affiliates are also generous sponsors of CMDITR, enabling us, for example, to sponsor REU and minority fellowships as well as defray meeting costs. We look forward to hosting representatives from Lockheed-Martin, Boeing, Eastman, and Ford the day after our Retreat. We will call on many members to help with oral and poster presentations for this one-day meeting. If you are not selected but would like to join in the day's activities, please let Cecile or Darcy know in advance.

Coming Events!

Feb 9-11, CMDITR Retreat and IAP Expo, Atlanta, GA

Feb 24, NSF Videoconference Meeting

Feb 25, Strategic Advisory Board Meeting, Seattle, WA

Jun 28-29, NSF Site Visit, Seattle, WA

Sep 8-9, STC Directors Meeting, Los Angeles, CA

Responsible Conduct of Research, Check our website for dates at your Institution

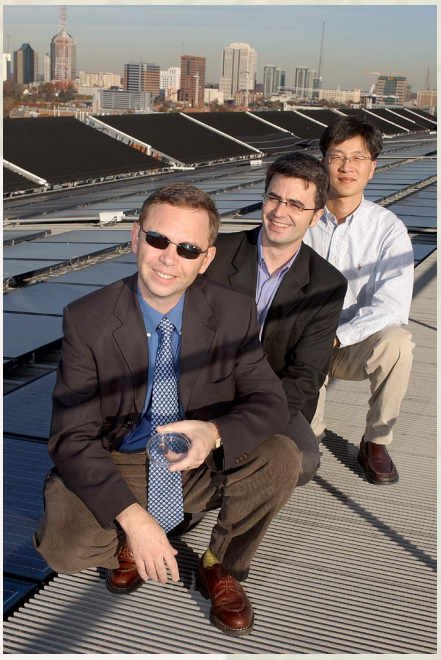
Send Us Your News!

Share your news and successes with fellow CMDITR collaborators.

Please send news flashes, information and feedback to vanpatten@chem.washington.edu

CMDITR
Department of Chemistry
Box 351700
University of Washington
Seattle, WA 98195
(206) 543-7464

Persistence Leads to Major Solar Cell Breakthrough!



Bernard Kippelen, Benoit Domercq, and Seunghyup Yoo from Georgia Institute of Technology

When I joined Professor Kippelen's group about four years ago I was attracted to the novelty of optoelectronic devices built with organic materials. Organics are usually considered insulators that are unsuitable for such applications. On my first visit to Prof. Kipplelen, he offered me an RA and suggested I work on organic solar cells. As an undergraduate, I had been interested in solar cells as a future topic of study, but I realized that research on solar cells using inorganic semiconductors was already saturated. Here I was, many years later, running into a different type of solar cell as my Ph.D. research subject. What a coincidence! It didn't take me long to accept the offer.

In the beginning, I felt like I could build anything. I still remember giving a lengthy presentation on background theory during my first group meeting and then rushing to the hospital to help my wife deliver our first child. Then reality hit! Even making decent films by spin-coating, which may be considered quite obvious and rudimentary, often challenged me at the beginning. My first devices in which I tried to reproduce published work, simply didn't perform as well as expected. Frustration and disappointment! I considered switching my research subject, but I found my mind was always preoccupied with organic solar cells. With time passing like an arrow, I had to face an important change: our group's move to Georgia Institute of Technology. It was apparent that this would cost me a delay of at least half a year to dismantle, move and reset up the labs. Ironically, it was that half year that gave my research a fresh boost. I was able to reflect on what I had done so far. I had ample time to go through the literature and equations step by step. Auditing Professor Rohatgi's class on solar cells familiarized me with the many different aspects of this technology. After several months of effort by all our group members and with the labs finally in place, I was fully recharged in terms of energy, resources, and mentality.

Finally everything worked like a charm. Benoit (Domercq, Ph.D, research scientist) and I were able to get nice characteristics from devices made from a known structure; performance was more or less comparable to published results. The results gave us confidence and momentum. After a few successful runs using those structures, we decided to try something of our own: solar cells based on pentacene and fullerene. Pentacene is an organic molecule that has been actively investigated as a material for field-effect transistors, but rarely for solar cells. Several groups, including ours, had demonstrated high polycrystallinity in pentacene film leading to large field-effect mobility, and we had a strong feeling that this aspect of pentacene might lead to efficient solar cells. And that was just right. On the evening of March 15th, 2003, I stared at the computer monitor showing the highest efficiency I had ever seen from one of our devices. It was simply an electrifying and heart-stopping moment. Frustrations accumulated over several years melted away. Moreover, after several trials and optimization, we not only reproduced but also improved our result, which gave us confidence in our data and demonstrated the feasibility of even further improvement. Well, I know my story is still ongoing. I may still be in the middle of a tunnel that showed me just a glimpse of the light from the other end. I hope to arrive at the end of that tunnel one day.

Before concluding this, I'd like to emphasize the importance of teamwork. Prof. Kippelen guided me all the way, reminding me that hard work would pay off someday and showing his persistent belief in me when I was struggling. Benoit, who shared all the humps and bumps that I've been through, purified all the materials, tried to familiarize me with the chemistry (often in vain) and the deposition system, and never minded exchanging ideas and opinions. Of course, I cannot thank enough the funding agencies for their generous financial support and especially, my family that always brings me the joy and love with which I can be refreshed everyday.

Seunghyup Yoo, Graduate Student in Prof. Kippelen's group , Georgia Institute of Technology

See page 3, "Tech Developing Efficient Organic Solar Cell" and http://www.gatech.edu/news-room for more information.

Tech Developing Efficient Organic Solar Cell

Researchers use pentacene to develop next-generation solar power
Atlanta (December 13, 2004)

As the price of energy continues to rise, businesses are looking to renewable energy for cheaper sources of power. Making electricity from the most plentiful of these sources - the sun - can be expensive due to the high price of producing traditional silicon-based solar cells. Enter organic solar cells. Made from cheaper materials, their flexibility and feather-weight construction promise to open up new markets for solar energy, potentially powering everything from Radio-Frequency Identification (RFID) tags to iPods and laptop computers.

Researchers at the Georgia Institute of Technology have developed a new approach to creating lightweight organic solar cells. By using pentacene, researchers have been able to convert sunlight to electricity with high efficiency. The research appears in the November 29, 2004 issue of the journal Applied Physics Letters.

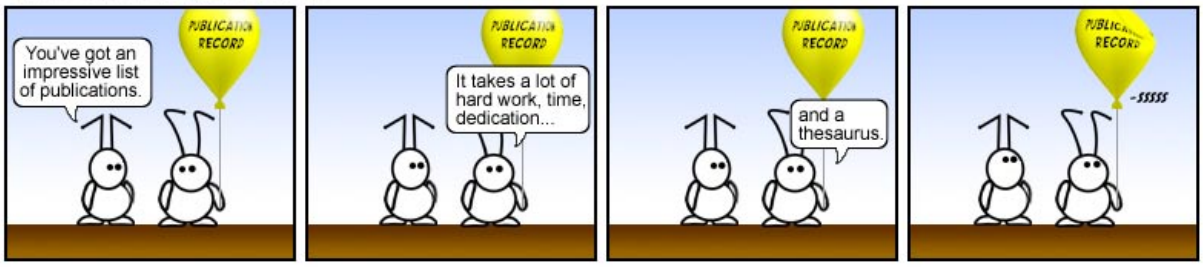
Press Release taken from the Georgia Institute of Technology website. For full article see:

http://www.gatech.edu/news-room/

Innovative Approach Dramatically Improves Performance of NLO Polymers

The Jen and Dalton research groups at the University of Washington have employed innovative nanoscale architectural approaches to dramatically improve the performance of nonlinear optical polymers. Exploration of a range of novel materials was facilitated through control over several critical design parameters, including size, shape, surface chemistry, flexibility and topology. By exploiting smartly-controlled microwave-assisted chemistry and creative processing/poling procedures, the efficiency of these materials has been significantly improved. The typical solubility limit of guest molecules in the host matrix has been greatly extended without affecting the dielectric and mechanical properties of these polymers. This is achieved through the site isolation effect from the fluorinated dendrons. Another novel synthetic route that has been developed to dramatically improve the performance of E-O materials is based on the very mild Diels-Alder chemistry. The Diels-Alder reaction allows the poling process to be performed at a low polymer viscosity, which promotes the efficient alignment of the NLO chromophores. The subsequent crosslinking process during cooling provides the poled materials with high thermal stability and excellent mechanical properties. The first generation Diels-Alder reaction-based materials have been successfully utilized to fabricate a high-speed Mach-Zhender modulator by Steier's group at USC. This device demonstrated both low drive voltage and long-term thermal stability at 100 °C. Very recently, the Jen and Dalton groups have achieved a major breakthrough in the development of electro-optic materials (AJ302). These materials demonstrate ultrahigh r33 values (> 300 pm/V @1320 nm) and represent a new family of novel monolithic glass materials. These preliminary results are encouraging and this inventive approach may help to launch a new paradigm for the molecular engineering of the next generation high-performance E-O materials.

Our more established polymer AJL8/APC has also been used as a material standard for use by several other universities (Steier-USC, Yariv and Scherer-Caltech, Hayden-Maryland, Peyghambarian and Fallahi-UA), and government labs (Lindsay-NAVY/China Lake, Paul Ashley-ARMY Redstone Arsenal, Jim Grote-AFRL, Warren Herman-LPS) in the fabrication of novel integrated optical devices. In conjunction with Boeing, we have successfully used a Diels-Alder reaction-based crosslinkable polymer to fabricate devices through nano-imprinting lithography. The collaborative efforts amongst the Jen and Dalton groups and these STC affiliates to develop electro-optic materials and devices are making a powerful impact on information technology.



The Critters by Mike Martelle

CMDITR Successfully Competes for Two URG Awards

In an effort to bolster the diversity enhancement efforts of all 11 currently funded NSF Science and Technology Centers, NSF's Office of Integrative Affairs sponsored a competition in Fall 2004 for approximately $900K entitled "Enhancing Participation of Underrepresented Groups in Science and Engineering through Specific Opportunities Fostered by NSF STCs".

A total of 16 proposals were submitted; three of which were authored by CMDITR. Of the two that were funded, one is focused on efforts specific to our Center and the other solicited participation by all STCs. Below are brief descriptions of these two programs.

New PhD Program Development at Norfolk State University ($48K) – This project aims to assure the successful implementation of a new Ph.D. program in Advanced Materials Science and Engineering at Norfolk State University (NSU), a historically black university. This program would be only the second Ph.D. program at NSU (the first being in Social Work), and only the second doctoral program in Materials Science and Engineering at an HBCU (the other being at Tuskegee University in Alabama).

STC-GEM Partnership to Expand the Pipeline ($100K) - This program pairs the recruitment needs of seven diverse STCs with the recruitment success of GEM, the National Consortium for Graduate Degrees for Minorities in Science and Engineering. The plan calls for a one-time direct infusion of cash to GEM to sponsor four fellowships, good at any STC-affiliated university. To solidify the partnership, an STC faculty contingent and 18 STC students from underrepresented groups will attend the GEM 'Future Faculty and Professionals Symposium' June 28-30, 2005 in Boston, MA.

In addition to the above, CMDITR co-authored a fourth funded URG proposal entitled: "Hands-On Future Tech at the STCs" ($96K). This project, hosted by the Center for Biophotonics Science and Technology (UC Davis), will bring scientists of all ages from four STCs and various URG or URG-serving institutions together in an informal, playful, and interactive workshop featuring leading edge science and technology demonstrations from each participating STC.

Hooked On Photonics! CMDITR Lands REU Site Grant

Hooked on Photonics? Most Center participants would admit they are, but now with new grant funding from NSF, we have an opportunity to help others become Hooked on Photonics (HoP) as well!

With UW Chemistry professor Phil Reid serving as PI, the Center was recently awarded an REU Site grant entitled, Hooked on Photonics. This award, at the level of $74K per year for three years will support lower-level undergraduates (termed Gateway students) in academically appropriate research experiences. The program focuses on Gateway students in an effort to engage students in research earlier in their academic experience. Education studies suggest early research experiences help retain students in their academic career trajectories. These studies, along with experience gained during last year's CMDITR funded Gateway REU program provide a solid foundation for the HoP program.

As Site proposals are specific to an individual institution, the program will be formally implemented at the UW, supporting a cohort of 9 students each summer. REU coordinators from UW, UA, and GT are meeting regularly to consider how best to implement the program across these campuses using CMDITR funds. In addition to lab experiences, the student cohorts at each university will participate in skill set workshops and content seminars. In developing the HoP proposal, 17 UW faculty members (from physics, chemistry, electrical engineering, mechanical engineering, materials science and engineering, and the applied physics lab) agreed to participate.

Ashley Hamilton-Ross working in Alex Jen's Lab at UW.

If you are interested in learning more about or participating in CMDITR summer REU experiences, please visit http://stc-mditr.org/REU or contact us at (206)616-9441 or reu@stc-mditr.org.

CMIDTR Welcomes Two New Directors

Director of Education, Simon Jones


Simon Jones

CMDITR welcomes a new Director of Education. Last Fall, after Dr. Jasmine Bryant resigned as Director of Education, the Center launched a nationwide recruitment to fill the vacancy. We are pleased to announce that this vacancy has been filled by Dr. Simon Jones. Simon will take up residence at the University of Arizona and officially start on January 31.

CMDITR's core effort in education has evolved increasingly toward graduate and undergraduate curriculum development in photonics and organic electronics. As a result, mastery of Center research concepts was a key criterion in our recruitment. Simon brings tremendous technical strength as a graduate of the University of Oxford (M. Chem. and Ph.D. Organometallic Chem.) and postdoctoral fellow in Seth Marder's research group since 2003. Simon was a lecturer at Oxford for four years and has a strong interest in teaching and improving the higher education process.

We look forward to Simon's teaming with Dana Riley Black and Mike Bruck to jump start development of CMDITR's signature course. PIs and students should anticipate personal visits from Simon over the next several months as he meets our membership and solicits ideas and help in packaging courses and seminars for use by Norfolk State University, REU interns, and our own undergraduate and graduate degree programs.


Keith Oden

Director of Diversity, Keith Oden

It is a pleasure to welcome Dr. Keith Oden as CMDITR's Director of Diversity. Working at Georgia Tech, Keith's responsibilities will include working with students, faculty and staff to coordinate the Center's diversity initiatives. In particular, Keith will help the Center recruit a diverse set of students and postdoctoral researchers and foster their academic careers, by helping to provide them with knowledge about fellowships and career opportunities as well as insights into effectively negotiating a successful path through their doctoral and postdoctoral studies. Keith's education and professional background make him ideally suited to spearhead the Center's efforts in diversity. He received a Bachelors of Arts – Psychology, from the State University of New York at Albany, a Masters of Science in Counseling Education at State University College at Brockport and his Ph.D. - Educational Policy Studies at Georgia State University, in Atlanta, GA.

Prior to joining the Center, Keith was the Director of Graduate Cooperative Education and Fellowship Programs, at Georgia Tech, where among other things he: provided guidance to undergraduate and graduate students regarding fellowships, fellowship policies, research interests and career planning; counseled and placed graduate students in co-op employment and corporate research positions; established linkages and cohesive strategies with faculty and academic units within the institute in reference to joint program initiatives between researchers, industry, faculty and students; and served as committee member and advisor to several minority student organizations.

Given his wealth of experience, it is clear that all CMDITR members will profit from interacting with Keith, and we look forward to a long productive interaction.

Resources for Graduate Students and Postdoctoral Researchers

- Travel Grant awards up to $1,000 for collaborating with other groups in the Center
- Web-based resume bank to reach potential employers

Visit our website for more information (http://stc-mditr.org/index.cfm)

Light Works

January/February 2005

CMDITR
Department of Chemistry
Box 351700
University of Washington
Seattle, WA 98195

What's Inside

Light Works

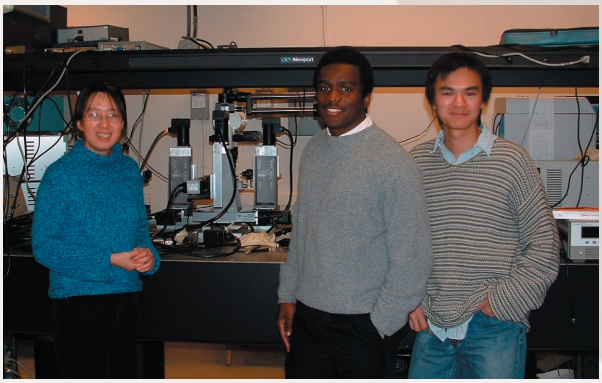
January/February 2005

Reflect on it...

University of Washington & Seafood

Terrell's trip was supported by a CMDITR travel grant. Log onto the CMDITR's Members' website for Travel grant details.

On my recent visit to the UW, I talked with the Jen and Dalton groups about the possibility of using surface plasmons to enhance the spontaneous emission rates and internal quantum efficiencies of OLEDs. I also served as a liaison and talked with the groups about a project that my colleagues are interested in pursuing regarding fabricating an organic laser for biosensing applications. When planning the visit, I wondered how I would manage to talk with group members given the different time constraints. After booking the flight, I set up a meeting or two and that seemed to get the ball rolling. Once I arrived, everything fell into place and I was able to talk to members from both Prof. Jen and Prof. Dalton's groups. It just so happened that the EO polymer group's bimonthly journal club was meeting the next day and I was able to participate.



Terrell Neal (middle) works with Michelle Liu and Angus Yip in Alex Jen's lab at UW.

After a day or so I felt I practically knew my way around Seattle, even though I had to use maps to get around on the first day. Over the course of the two days I had my share of salmon, halibut, and tilapia. The seafood was so great that I did not notice that the sun chose to hide the whole time I was there.

While there I also made time to stop by the STC office to meet Darcy and Glen, take a few pictures around campus, and check out the view from the Space Needle telescopes.

Terrell D. Neal, Ph.D Candidate Electrical Engineering
Caltech Nanofabrication Group