Please join me in congratulating Wilfred Chen for being awarded the 2012 Biotechnology Progress Award for Excellence in Biological Engineering Publication, which will be presented to him at the AIChE meeting in Pittsburgh!

Congratulations to Alexandra Bayles who received the Best Junior in Chemical Engineering from the Delaware Section of ACS. She will be presented this award at the local ACS meeting at the DuPont Country Club on Thursday, September 27th. http://delacs.sites.acs.org

This Week’s Department Events:

- **CMET Seminar**
  “Colloids with Directional Interactions”
  David Pine, New York University
  Thursday, September 13, 2012
  1:30 pm – 366CLB

- **The Colburn Club will be hosting the annual Chemical Engineering Fall Picnic on Saturday September 15, 2012 at Lums Pond State Park.** The picnic will begin at 11am in area 2, the picnic area right next to the pond and boat launch. We will be providing sandwiches, beverages, and other typical picnic food for this event. Feel free to bring frisbees, soccer balls, or anything else you’d like for fun. The boat rental will also be open that day if you would like to enjoy some canoeing or kayaking on the pond. We kindly request that you RSVP to either Chris (CLB 119) or Angie (CLB 151) and contribute $5 towards the cost of food and beverages by Thursday 9/13. Please be aware that parking for this event is not funded by the department and must be paid upon entering the park. The cost is $3 for Delaware registered vehicles or $6 for out-of-state registered vehicles. Also, we are looking for people to lend coolers for use for this event. If you have one you are willing to let us borrow, please let us know! If you have any questions, feel free to contact either Chris (cjobrien@udel.edu) or Angie (holmberg@udel.edu).

- **AIChE 2012 Annual Meeting Registration**
  Early Bird Rates Valid Until September 14, 2012
  HOTEL: Rooms available from October 28th through November 2
  Rates from $175, Reserve on or before Saturday, October 6

In the News:

- **Gerster Memorial lecture: William J. Koros**
  http://www.udel.edu/udaily/2013/sep/gerster-lecture-090512.html

- **Named Chair, Meehan named Bentley Systems Incorporated Chair of Civil Engineering**
  http://www.udel.edu/udaily/2013/sep/meehan-bentley-professor-090712.html

Facilities:

- **Please prepare for a chilled water shutdown all day Saturday, September 8th.**
  A similar shutdown is scheduled the following Saturday, September 15th to continue the chilled water repair AND to perform preventative maintenance on the air handler units. Please refrain from performing lab operations on the 15th during the ventilation upset.

- **U/D Facilities Maintenance has scheduled an 8-hour chilled water shutdown on Sept 8th to begin the diagnosis and repair of our chilled water flow issues.**
  It's believed that the valve disc has separated from the stem on a large control valve, causing restricted flow. This shut down will knock out chilled water including cooling water for x-ray equipment and lab processes on chilled water. Other lab services like compressed air, building cooling and dehumidification, and the distilled water supply are also off-line during this work.
Future Department Events:

- You are cordially invited to Brett Guralnick’s dissertation defense entitled "Plastic Solar Cell Interface and Morphological Characterization." The defense will be held on Monday, September 17th at 8:30 am in CCM 106. Refreshments will be available at 8:15 pm. An abstract is attached.

- **Department Seminar: Jack A Gerster Memorial Lecture**
  
  William J. Koros, Georgia Institute of Technology
  
  Friday, September 21, 2012
  
  10:00am in 102CLB
  
  “Membranes & Sorbents: Large Scale Separation Change Agents”

Other Department Events:

- **Discrete Math Seminar**
  
  Anvind Ayyer, University of California, Davis
  
  Tuesday, September 11, 2012
  
  4:00pm in 336 Ewing Hall
  
  “Markov chains based on Jeu de Taquin”

- **Hallenbeck Graduate Student Seminar**
  
  Brooks Emerick, University of Delaware
  
  Wednesday, September 12, 2012
  
  12:10pm in 336 Ewing Hall
  
  “Turning Instability”

- **Teaching Seminar**
  
  Mike Fernbacher, University of Delaware Office of Student Conduct
  
  Thursday, September 13, 2012
  
  11:00am in 205 Ewing
  
  “Academic Honesty”

- **Physics and Astronomy Fall Colloquium**
  
  Dr. Philip Bustard, National Research Council, Ottawa
  
  Monday, September 10, 2012
  
  2:15pm in 215 Sharp Lab
  
  “Raman scattering: control and randomness”

Jobs/Recruiting:

Available positions can be found on the Chemical & Biomolecular Engineering opportunity website (http://www.che.udel.edu/biz/OppIndex.html), so be sure to check it regularly.
Plastic Solar Cell Interface and Morphological Characterization - Abstract

Brett W. Guralnick

September 2012

Modern society is driven by energy, and currently a crisis is approaching as cheap and clean energy sources are becoming more scarce. The world population continuously grows, while more of the world seeks a higher standard of living requiring a higher energy load. There will be no “silver-bullet” or singular solution to this problem but a multi-tiered approach. One of the corner stones of solving the energy issues will be solar energy. This is a vast and renewable resource. However, current technology is still too expensive to compete with fossil fuels and existing energy infrastructure. It is predicted that as time moves forward this may change.

While the future may see an increase in the current technology utilization, the demand is starting now. With the discovery of semiconducting polymers, new organic materials can now be synthesised and new systems explored. These systems can drive down cost and weight while also being flexible and aesthetic. These qualities are so apparent that the amount of research is growing exponentially.

An active area of research for organic photovoltaics is the characterization of the morphology and how this morphology contacts the terminal surfaces. The focus of this thesis is the blend and self assembly of the organic layer. Two organic components are required to achieve high efficiencies in organic photovoltaics and due to this, neutrons which have a high contrast to different organic molecules, are ideally situated for characterizing and studying these systems.

The characterization techniques used in this thesis include a blend of neutron and x-ray characterization, surface measurement techniques, diode as well as incident light analysis that provided information on how the morphology is formed and to also better understand how organic photovoltaics operate.

The morphology formed internally in the bulk heterojunction is difficult to characterize and the use of polarized neutron reflectivity was pioneered in this thesis. This technique takes advantage of the spin state of neutrons and the interactions with a magnetic material to create a varied contrast layer. This contrast reduces the ambiguity of the fitted profile and a high
confidence in the scattering length density profile validity is achieved.

The key findings are that while annealing increases the crystallinity parallel to the substrate, the morphology is largely unchanged following thermal annealing. The processing conditions from solution are important for the bulk heterojunction formation. The spin coating speed, concentration, solvent, and mixing time all play a role in how the bulk heterojunction forms on the substrate. In addition, the inclusion of the terminal or inorganic layers in these systems is critical because thin film devices have a high surface to area ratio. Lastly, the deposition and fabrications conditions matter as to how the device self assembles and performs and this thesis exposes the morphology changes as it applies to organic photovoltaics.

The interface between layers changes the device performance. A highly resistive transparent conducting oxide layer limits device performance. It was discovered that the electron blocking layer between the transparent conducting oxide and the bulk heterojunction is compromised following annealing. The electron acceptor material can diffuse into this layer. A study of the morphology was therefore critical because this was previously unknown. Additionally, the back contact deposition parameters are important because the organic material can be damaged by the deposition. Depositing a thin thermal and momentum blocking layer prevents damage which ultimately leads to higher efficiencies.

One of the limitations on device performance currently is the materials. New materials have been synthesized with better electronic properties and stability. The characterization of the polymer properties of these new materials is important. One new promising polymer was studied and it was found that the polymer behaves similarly to previously studied polymers and therefore it is the improvement of the electronic properties that lead to improved efficiencies.

The analysis techniques presented will be important as new materials, design structures, electronic properties, and plastic solar cell modules are designed. Understanding and characterizing the internal material properties will ultimately allow higher efficiencies to be achieved.