ASP NEWS

Connect

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Message from the President

The winter council meeting is currently scheduled for January 18, 2015. With this in mind, I would like to re-invigorate participation by society members in the various committees that form the working lifeblood of our society and personally invite all members to send suggestions. To that end, there are several committees assigned to help implement our strategic vision of increasing the participation and presence of ASP in photobiology research, practice and education between biannual meetings by exploiting online resources.

The Education Committee is chaired by Joanna Turner and will plan an online poster session and increase online society participation initiatives such as interactive forums on our website.

The Outreach Committee is chaired by Alec Greer and is tasked with increasing and invigorating membership and working to increase the presence of the society online using research based social networking sites.

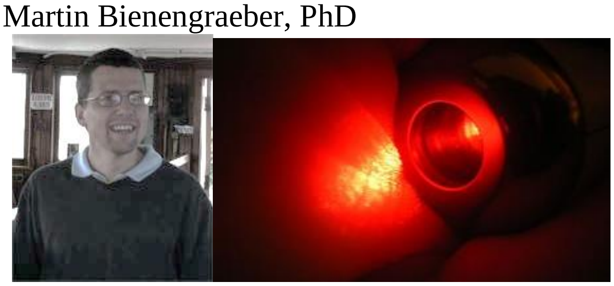
The Publication Committee is chaired by Jonathan Lovell, and will work to communicate members via our newsletters and our website as well as act as a liaison between council and Photobiological Sciences Online (PSO) and Photochemistry and Photobiology.

In the coming weeks, we will prepare the agenda for the meeting and are planning an open invitation for all members to participate in the teleconference. I urge all of you to share any of your ideas for meeting our strategic vision with the chairs of these committees before or after the meeting and consider volunteering to serve on a committee to see these ideas put into practice. In addition to these important topics, we will also be discussing how to better incorporate Associate Members into our society and how we can enhance the resources and value the ASP provides this next generation of photobiologists.

-Keith Cengel

Meet a Photobiologist:

Martin Bienengraeber, PhD



Medical College of Wisconsin, Milwuakee

Questions & Answers

Q: *What area of photobiology are you working in?*
A: I'm studying photobiomodulation, also known as low level light therapy (LLLT). My background is in mitochondrial biology and I moved into photobiology applications about 5 years ago.

Q: *I just was reading about that for pain treatment. How are you applying LLLT?*
A: Pain is perhaps the most heavily used LLLT area with respect to lay-people. From a scientific point of view, many are working on LLLT for wound healing, particularly mucositis. The field has expanded a lot recently even to conditions like Alzheimer's and PTSD. We are examining LLLT as a method to improve heart tissue survival after cardiac ischemia and reperfusion. I am in an anesthesiology department, and it has been shown that volatile anesthetics can have a protective effect during reperfusion in animal models, but that doesn't hold up in all patients with underlying conditions such as diabetes and high age. Light therapy has the same benefits but and maybe will be more promising to actually work.

Q: *Are other groups working on cardiac LLLT?*
A: There are some. One group in Israel is using a similar approach, but not looking at reperfusion, but rather chronic infarctions. In our case, we are interested in a one-time photobiomodulation application at the time of reperfusion.

Q: *Do you see cardiac LLLT translating to the clinic soon?*
A: There will be hurdles. Our research is funded by the NIH and this issue came up during the grant review. We were able to work out a transesophogeal probe for light delivery. From talking with cardiologists, it will be challenging but not impossible to integrate this step into current practice, which is already stressful. But also from an academic and basic research point of view, our system, which uses small animals, is useful to look at anatomy, physiology and mitochondrial biology to understand mechanisms.

Q: *Have you worked out that mechanism yet?*
A: That is quite complex and there are somewhat conflicting theories out there, both in the literature and in our own data. The classical idea of photobiomodulation involves an enhancement of mitochondrial bioenergetics, increasing ATP and respiration through light action on cytochrome c oxidase. This is likely true under some stress condition, but as a mitochondrial biologist, I always felt this theory a little difficult to reconcile with our cardiac injury model since mitochondrial processes are highly regulated. Some of our key findings have shown that nitric oxide generation is enhanced by unusual photomechanisms involving hemoglobin and myglobin, and maybe other porphyrin-containing proteins.

Q: *What will you work on once the mechanism is resolved?*
A: We will have to make sure that the application of light on the heart can make it to the clinic. Going forward, we and others have found evidence that light is able to induce angiogenesis and that will have many potential applications.

Q: *Did you encounter challenges when you started working with light in your research?*
A: Yes, we did since we were new to it. As an example, it took us a while to realize that our control samples should have be kept in the dark. We had to get used to photonics terminology and concepts and that took some time but now we have got the hang of it mostly. There are still some challenges for us knowing how deep the light penetrates the heart.

Q: *As a LLLT researcher, how do you find ASP?*
A: There are also several laser conferences that cover LLLT research. I think the ASP is a little broader in scope in nature. What I like about the ASP is that it is a very scientific and rigorous society. It is clear the members are fully dedicated to science.

-We caught up with Martin Bienengraeber by phone.

We need YOU!

Please submit content (science highlights, suggested links, personal stories, etc) to the ASP News.
Email: jflovell@buffalo.edu

Historian’s Corner: State of Science

A few years back I wrote an article for a Journal with the somewhat ambiguous title 'Chest' relating to the NIH granting situation. [Writing successful grant applications for preclinical studies. Chest.130, 296-298, 2006]. This was translated into several Asiatic languages. This is now more than a bit out of date. It might be useful to see what has happened over the years and why the NIH granting situation has become considerably more severe.

When I first begin submitting those traditional R-01 investigator-initiated grant proposals, it was all done on paper. Multiple copies needed to be submitted and there were periodic images sent around of fork-lifts moving huge piles of paper in some NIH facility **(Figure 1)**. The results of the review process would eventually be returned on pink paper (the infamous 'pink sheets') and one had to really come up with something preposterous to get a bad score). Anything with a reasonable chance of success was considered worth at least one funding interval. So the move from graduate student to post-doc to assistant professor was not a 'big deal'. The general rule was that sometime with ideas ought to be able to make the transition from new PhD to Professor with tenure in about 15 years.

Figure 1: NIH loading dock on the day grant applications were due in 2001 prior to electronic submission. From sciencemag.org.

It must be admitted that in earlier days, research was much less expensive, with the typical lab equipment needed amounting to a pH meter, an incubator, a thermometer, a refrigerator, a homogenizer and the availability somewhere of a fume-hood, perhaps a tissue-culture hood, a centrifuge, a spectrophotometer and a freezer. As things got more complicated, the expensive stuff piled on and costs went up.

While the direction of much of early research was somewhat directed toward distinct goals, there was still a reasonable opportunity for just messing around. Baruch S. Blumberg was quoted as saying that he liked to 'do lots of experiments and let some result surprise me'. This approach did result in a Nobel Prize (1975) but would lead to early triage today. I periodically remind people that siRNA was found by someone trying to change the color of petunias, but citing this approach in new proposals today is likely not going to be well received.

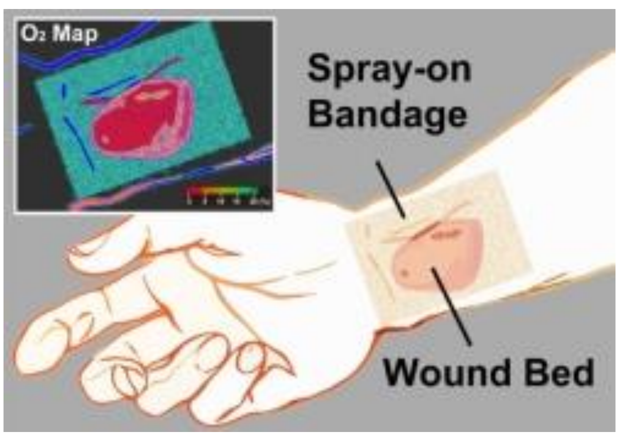
With a combination of perhaps over-selling scientific academic careers and the curtailing funding opportunities, there is no question but that the route from graduate student to tenured professor has become much more precarious. After decades of interesting discoveries that seemed to have no payback, Congress and the granting agencies are emphasizing what has come to be termed 'translational research'. The implication is that there are 'shovel ready' projects out there that only need to be identified and explored to have a quick and positive health-promoting outcome.

This may be true, and perhaps too much effort and money has been directed toward ultimately irrelevant studies. It is not, however, clear that the net effect of shutting down a considerable portion of the academic research effort will lead to a more positive and efficient result. We in the United States may be in the process of losing a generation of the best and brightest who will be seeking out careers with more security and survival potential, e.g., clinical medicine, marketing, banking and the operation of hedge funds.

-David Kessel

Photomedicine: O_2 Sensing Bandages

Inspired by a desire to help wounded soldiers, an international, multidisciplinary team of researchers led by Assistant Professor Conor L. Evans at the Wellman Center for Photomedicine of Massachusetts General Hospital (MGH) and Harvard Medical School (HMS) has created a paint-on, see-through, "smart" bandage that glows to indicate a wound's tissue oxygenation concentration. Because oxygen plays a critical role in healing, mapping these levels in severe wounds and burns can help to significantly improve the success of surgeries to restore limbs and physical functions. The work appears in The Optical Society's journal *Biomedical Optics Express*.



The transparent liquid bandage displays a quantitative, oxygenation-sensitive colormap that can be easily acquired using a simple camera or smartphone.

Now, the "smart" bandage developed by the team provides direct, noninvasive measurement of tissue oxygenation by combining three simple, compact and inexpensive components: a bright sensor molecule with a long phosphorescence lifetime and appropriate dynamic range; a bandage material compatible with the sensor molecule that conforms to the skin's surface to form an airtight seal; and an imaging device capable of capturing the oxygen-dependent signals from the bandage with high signal-to-noise ratio.

This work is part of the team's long-term program "to develop a Sensing, Monitoring And Release of Therapeutics (SMART) bandage for improved care of patients with acute or chronic wounds," says Evans, senior author on the *Biomedical Optics Express* paper.

For starters, the bandage's not-so-secret key ingredient is phosphors—molecules that absorb light and then emit it via a process known as phosphorescence.

Phosphorescence is encountered by many on a daily basis—ranging from glow-in-the-dark dials on watches to t-shirt lettering. "How brightly our phosphorescent molecules emit light depends on how much oxygen is present," said Li. "As the concentration of oxygen is reduced, the phosphors glow both longer and more brightly." To make the bandage simple to interpret, the team also incorporated a green oxygen-insensitive reference dye, so that changes in tissue oxygenation are displayed as a green-to-red colormap.

The bandage is applied by "painting" it onto the skin's surface as a viscous liquid, which dries to a solid thin film within a minute. Once the first layer has dried, a transparent barrier layer is then applied atop it to protect the film and slow the rate of oxygen exchange between the bandage and room air—making the bandage sensitive to the oxygen within tissue.

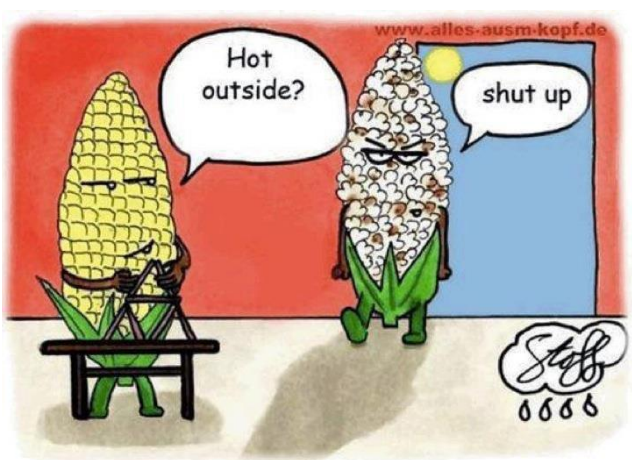
The final piece involves a camera-based readout device, which performs two functions: it provides a burst of excitation light that triggers the emission of the phosphors inside the bandage, and then it records the phosphors' emission. "Depending on the camera's configuration, we can measure either the brightness or color of the emitted light across the bandage or the change in brightness over time," Li said. "Both of these signals can be used to create an oxygenation map." The emitted light from the bandage is bright enough that it can be acquired using a regular camera or smartphone—opening the possibility to a portable, field-ready device.

Immediate applications for the oxygen-sensing bandage include monitoring patients with a risk of developing ischemic (restricted blood supply) conditions, postoperative monitoring of skin grafts or flaps, and burn-depth determination as a guide for surgical debridement—the removal of dead or damaged tissue from the body.

"In the future, our goal for the bandage is to incorporate therapeutic release capabilities that allow for on-demand drug administration at a desired location," says Evans. "It allows for the visual assessment of the wound bed, so treatment-related wound parameters are readily accessible without the need for bandage removal—preventing unnecessary wound disruption and reducing the chance for bacterial infection."

Beyond the lab, the team's aim is to move this technology from the bench to the bedside, so they are actively searching for industry partners. They acknowledge research support from the Military Medical Photonics Program from the U.S. Department of Defense, and National Institutes of Health.

-source: Angela Stark, astark@osa.org



Photosterilization: Cheap Drinking Water From The Sun, Aided By A Pop Of Pencil Shavings

Piscine Molitor "Pi" Patel did it to survive on the Pacific Ocean. Robert Redford used the trick in All Is Lost.

When you're trapped on a boat, you can easily make fresh water, right? Simply let the sun heat up and evaporate salt water. Then trap the steam, condense it on a plastic surface and collect the fresh water. The liquid even gets sterilized in the process.

So why can't people around the world who lack clean drinking water do something similar?

Turns out, desalinating or sterilizing water with solar energy is way harder than Hollywood makes it look. The process is super inefficient and way too slow to be practical.

"The average yield is only about 1 cup per day," says the U.S. Air Force survival guide, even when you've got eight hours of sun and plenty of water.

But engineer Hadi Ghasemi, at the University of Houston, is trying to change that. He and a team at the Massachusetts Institute of Technology have developed a cheap material that desalinates water efficiently and fast using solar energy. And the secret to the new technology was sitting right on their desks: the graphite in pencils.

A simple solar still — and even more expensive versions with mirrors and lenses — heats up the entire water surface before it starts to evaporate, Ghasemi says. That takes time and wastes energy.

"Why do we need to heat the bulk of the liquid to get steam?" Ghasemi says. "Why not concentrate the solar energy at 'hot spots?' " Then all the energy goes into creating steam.


Solar sponge: The top layer of graphite soaks up the sun's energy in tiny holes. When drops of liquid fill the holes, the water quickly evaporates. (The beaker looks hot, but the water below the sponge is cool).

The trick to creating these "hot spots" is having the right material, he says. And that's where the graphite in pencils comes into play.

"We took graphite and put it into the microwave for seven seconds," Ghasemi says. The gases in the mineral cause the outer layer to expand and pop. "It's exactly like a popcorn!"

The result is a thin, porous material that looks like a black sponge. It floats on the surface of water, like a sponge. But instead of soaking up liquid, the pores soak up the sun, Ghasemi and his colleagues reported in the journal Nature Communications back in July.

The graphite has holes in it with just the right shape to concentrate solar energy and create tiny hot spots in the graphite. Water creeps into the holes through capillary action (just as water moves up the stem of a plant to its leaves). The droplets then heat up quickly and evaporate.

"It creates steam at a low concentration of solar energy," Ghasemi says. "So you don't need such expensive optical systems to concentrate the solar energy."

Ghasemi and his team still have many kinks to iron out before they can turn the technology into a useful product. A major one is what to do with all the salt.

"When water desalinates, it leaves behind the salt. Eventually the pores [of the graphite] will be clogged," says Gang Chen of MIT, who led the study. "We need to figure out how to handle that."

Although the material is highly efficient at converting solar energy into steam, the material still requires a cheap lens or mirror to concentrate sunlight by about tenfold. (By comparison, other technologies require 1,000-fold concentration of the light, which requires expensive optics.)

"We want to further reduce the concentration of sunlight needed," Chen says. "Then the technology wouldn't need fancy tracking technology to keep the sun focused on it."

Still, though, Chen is excited about developing the sun sponge for a myriad of other applications, such as making steam power and drying up surfaces after floods.

"The raw materials are very cheap compared to those used in other solar power generation now," he says. "The idea is just so simple. I don't know why we didn't think about it earlier."

-source: Michaeleen Doucleff, NPR, @FoodieScience

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Young Achievers: INTEL STS Semi-Finalist first author on P&P paper

Alex Buhimschi (Yale 2017) is the first author on a paper entitled "*UVA and UVB-Induced 8-Methoxypsoralen Photoadducts and a Novel Method for their Detection by Surface Enhanced Laser Desorption Ionization Time of Flight Mass Spectrometry (SELDI-TOF MS)*" that appeared in last year's November/December issue of Photochemistry and Photobiolgy. Alex completed this study while enrolled at Hamden Hall Country Day School, a private high school near New Haven CT. In his high school career, Alex had many outstanding achievements including scores of 5 on 7 AP exams. At graduation in June, he was the salutatorian speaker. He was also selected as an INTEL STS semifinalist and won a silver medal at the UConn Junior Science & Humanities Symposium in March.

Alex began his research studies in the Fall of 2011 when he was introduced to the field of psoralen photobiology by Dr. Frank Gasparro who has been teaching at Hamden Hall since 2004. Alex became so immersed in the project that he spent seven weeks of the summer between his junior and senior years working on the project at Duke University. He quickly became an integral part of the team, investigating a new approach relating to the use of psoralen for treatment of implanted tumors (in mice?) During his senior year, Alex prepared the first draft of the manuscript and incorporated modifications suggested by Dr. Gasparro. When the first reviews requested additional data, the experiments were performed, the manuscript was resubmitted in June and accepted in late August.

While awaiting final word on the manuscript, Alex was invited back to Duke for the summer where he provided further assistance contributing to the design for the treatment of implanted tumors with Psoralen and UVA radiation. Alex has already begun to make his mark at Yale as he was one of 60 freshmen to be selected for the highly touted Perspectives in Science seminar program.

-Frank Gasparro

Upcoming Photobiology Events

ASP 38: May 21-25, 2016, Tampa Bay

The time and place has been set! Mark your calendar and plan on joining ASP for the next conference.

We will highlight the upcoming meeting and the destination in the newsletter.

June 28-July 3, 2015
Jeju, Korea
The 27th International Conference on Photochemistry
http://www.icp2015.org/

Other Event Calendars

SPIE Events: http://spie.org/x1375.xml
Plant Biology Events: http://aspb.org/calendar
Chemistry Events: http://www.chemistry.org
Gordon Research Conferences: http://www.grc.org
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