BRAIN WAVES

Neuroscience Training Program | Semiannual Newsletter | Spring 2015

In this issue

Research News: p01
New Window into the Brain
UW Researchers, including NTP faculty member Justin Williams, use see-through sensors to view brain activity

New Faculty p02

Awards & Achievements p02

Grad Program Honored for Closing Science-Society Gap p03
Neuroscience and Public Policy Program awarded Neuroscience Graduate Program Achievement Award

2015 Neuroscience Symposium Recap p04
Summary by NTP Student, Maia Pujara

SEE-THROUGH SENSORS OPEN NEW WINDOW INTO THE BRAIN

By: Renee Miller
UW-Madison News

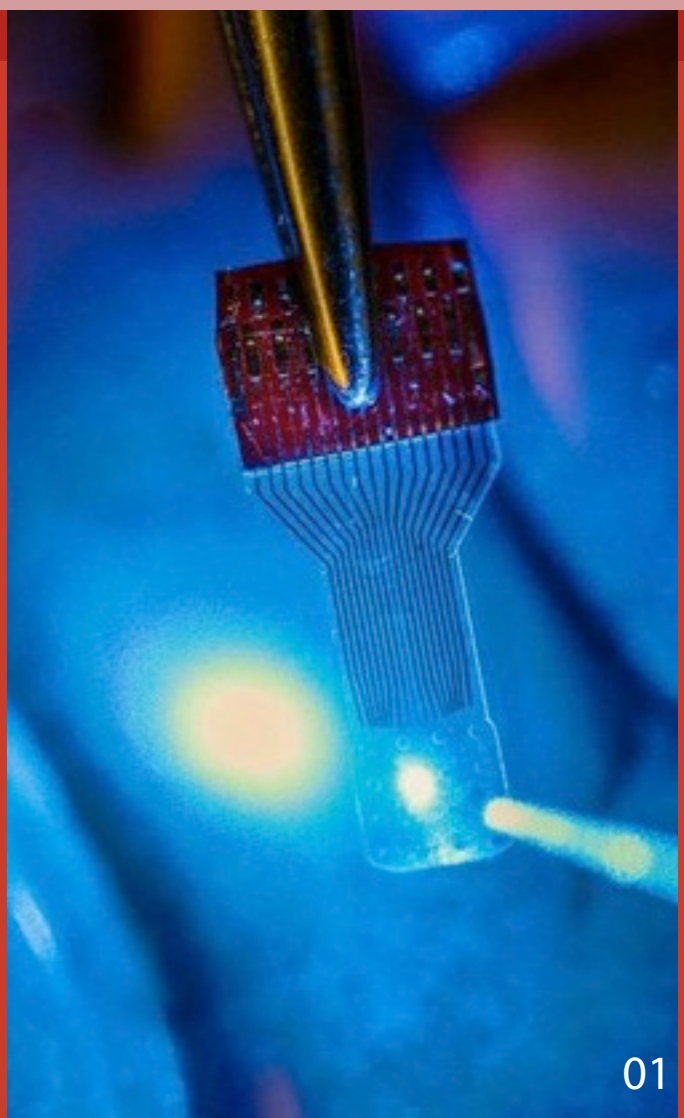
Developing invisible implantable medical sensor arrays, a team of University of Wisconsin-Madison engineers has overcome a major technological hurdle in researchers' efforts to understand the brain.

The team described its technology, which has applications in fields ranging from neuroscience to cardiac care and even contact lenses, in the Oct. 20 issue of the online journal Nature Communications.

Neural researchers study, monitor or stimulate the brain using imaging techniques in conjunction with implantable sensors that allow them to continuously capture and associate fleeting brain signals with the brain activity they can see. However, it's difficult to see brain activity when there are sensors blocking the view.

"One of the holy grails of neural implant technology is that we'd really like to have an implant device that doesn't interfere with any of the traditional imaging diagnostics," says Justin Williams, a professor of biomedical engineering andneurological surgery at UW-Madison. "A traditional implant looks like a square of dots, and you can't see anything under it. We wanted to make a transparent electronic device."

The researchers chose graphene, a material gaining wider use in everything from solar cells to electronics, because of its versatility and biocompatibility. And in fact, they can make their sensors incredibly flexible and transparent because the electronic circuit elements are only 4 atoms thick—an astounding thinness made possible by graphene's excellent conductive properties. "It's got to be very thin and robust to survive in the body," says Zhenqiang (Jack) Ma, a



(from page 1) **flexible, and a good tradeoff between transparency, strength and conductivity."**

Drawing on his expertise in developing revolutionary flexible electronics, he, Williams and their students designed and fabricated the microelectrode arrays, which — unlike existing devices — work in tandem with a range of imaging technologies. "Other implantable microdevices might be transparent at one wavelength, but not at others, or they lose their properties," says Ma. "Our devices are transparent across a large spectrum — all the way from ultraviolet to deep infrared."

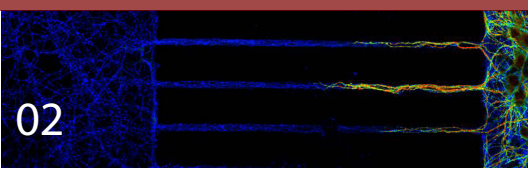
The transparent sensors could be a boon to neuromodulation therapies, which physicians increasingly are using to control symptoms, restore function, and relieve pain in patients with diseases or disorders such as hypertension, epilepsy, Parkinson's disease, or others, says Kip Ludwig, a program director for the National Institutes of Health neural engineering research efforts. "Despite remarkable improvements seen in neuromodulation clinical trials for such diseases, our understanding of how these therapies work — and therefore our ability to improve existing or identify new therapies — is rudimentary."

Currently, he says, researchers are limited in their ability to directly observe how the body generates electrical signals, as well as how it reacts to externally generated electrical signals. "Clear electrodes in combination with recent technological advances in optogenetics and optical voltage probes will enable researchers to isolate those biological mechanisms. This fundamental knowledge could be catalytic in dramatically improving existing neuromodulation therapies and identifying new therapies."

The advance aligns with bold goals set forth in President Barack Obama's BRAIN (Brain Research through Advancing Innovative Neurotechnologies) Initiative. Obama announced the initiative in April 2013 as an effort to spur innovations that can revolutionize understanding of the brain and unlock ways to prevent, treat or cure such disorders as Alzheimer's and Parkinson's disease, post-traumatic stress disorder, epilepsy, traumatic brain injury, and others.

The UW-Madison researchers developed the technology with funding from the Reliable Neural-Interface Technology program at the Defense Advanced Research Projects Agency.

While the researchers centered their efforts on neural research, they already have started to explore other medical device applications. For example, working with researchers at the University of Illinois-Chicago, they prototyped a contact lens instrumented with dozens of invisible sensors to detect injury to the retina; the UIC team is exploring applications such as early diagnosis of glaucoma.



AWARDS & ACHIEVEMENTS

Congratulations to the following students and faculty for their achievements:

Andrew Merluzzi, NTP student, received the 2015 NSF GRFP. He was also published in the *Observer* with his article titled, "Investigating Protections Against Dementia."

Annie Racine, NTP student, received a Merit Abstract Award for the 2015 Organization for Human Brain Mapping Annual Meeting in Honolulu, Hawaii.

Antoine Madar, NTP student, was awarded the 2015 Lily's Fund for Epilepsy Research Fellowship.

Baron Chanda, NTP faculty member, was awarded the Romnes Faculty Fellowship.

Corinne Jones, NTP student, was awarded 3rd place for scientific abstract for her talk "Pharyngeal pressure gradient phenotypes in patients with cricopharyngeal prominence" at the Dysphagia Research Society meeting.

Do Tromp, NTP student, received a Society for Biological Psychiatry's 2015 Domestic Travel Fellowship Award.

Giulio Tononi & Chiara Cirelli , NTP faculty members, won a $7.7 million grant from the National Institute of Neurological Disorders and Stroke to study 'local' sleep.

Luis Populin, NTP faculty member, was awarded the Hartwell Individual Biomedical Research award for his resesarch on therapies for ADHD.

Scott Vermilyea, NTP student, received a travel award from the American Society of Neural Therapies and also recieved 2015 NSF GRFP Honorable Mention. Scott was also chosen as a winner of the 2015 Cool Science Image Contest, his image can be seen on p.04.

Taehee Kim, NTP student, received the American Heart Association pre-doctoral fellowship.

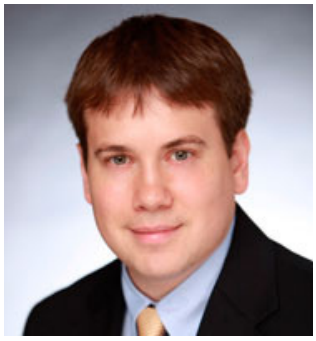
Umadevi Wesley, Robert Dempsey, & Dr. John S. Kuo, NTP faculty members, received a pilot project award from UW Carbone Cancer Center-Tumor Micro-Environment (TME) Program.

Yuri Saalmann, NTP faculty member, was a recipient of the 2014 Young Investigator Grant.

WELCOME NEW FACULTY!

Randolph Ashton
Assistant Professor,
Department of Biomedical Engineering
Neural stem cell derivation, differentiation, and tissue morphogenesis.

Timothy T. Rogers
Assistant Professor,
Department of Psychology
Visual perception, semantic memory, learning in amnesia and dementia, and verbal fluency.



David Plante
Assistant Professor,
Department of Psychiatry
Study of sleep disorders using magnetic resonance spectroscopy and high-density electroencephalography.

GRAD PROGRAM HONORED FOR CLOSING SCIENCE-SOCIETY GAP

By Chris Barncard
UW-Madison News

The University of Wisconsin–Madison's Neuroscience and Public Policy Program was recently honored by the Society for Neuroscience with the Neuroscience Graduate Program Achievement Award.
Ron Kalil — a neuroscientist, professor of ophthalmology and visual sciences and director of the Neuroscience and Public Policy Program — accepted the award Sunday in Washington, D.C., at the society's annual meeting.

"It's gratifying that the work our students and faculty have done since the program was established in 2005 will be recognized this way," Kalil says. "They have a lot to be proud of."

The UW–Madison program was honored as this year's top graduate program in neuroscience in the country. The University of Washington's neurobiology program took the undergraduate honors.
The UW–Madison program has added two or three students a year since 2005, expanding from one track on neuroscience and public policy to include a specialization in international policy and another in neuroscience and the law.

Each student earns a doctorate in neuroscience alongside a master's degree in international affairs or public affairs from the La Follette School of Public Affairsor a Juris Doctor from UW–Madison's School of Law.

"These days, when we look at students, we're considering people who are already trying to do things we can help them accomplish," Kalil says.

One recent student entered the UW–Madison program after serving as scientific ambassador to

the community around the college where she earned her undergraduate degree. Another spent time consulting on psychology issues with a national magazine. A third had been trying to engage policy makers in science discussions since high school.

Sometimes, the worlds of science and public policy seem to occupy different planets. That's where graduates of programs like UW–Madison's can help.

"There is a wide gap between science and society in general. Taken as a whole, scientists have done a poor job describing the way they think and work," Kalil says. "So we have a big problem: How do you get policymakers to consider science, to take the best of what we know into account, when they're trying to make the world better through government and laws?"

By training people to be both good scientists and effective advocates.

With the help from the Kavli Foundation, the Neuroscience and Public Policy Program brings to campus examples of success in both spheres — like biochemist and former National Academy of Sciences President Bruce Alberts and psychologist Alan Leshner, chief executive officer of the American Association for the Advancement of Science (AAAS).

Current and past N&PP students accept the Neuroscience Program Achievement Award with N&PP Director, Ron Kalil, and Student Services Coordinator, Mallory Musolf.

The program also works to give members of the scientific community and policy community a window into the other camp. This summer, the program hosted an AAAS workshop for judges in Madison on the state of the science in pain, substance abuse and violence — among other topics.

"These judges are asked to sentence people, but often they don't know what was going on in the heads of the accused when they did wrong," Kalil says. "Whenever we can find a way to close the gap between the science and the people who can put it to use, society benefits."

CONGRATS FALL GRADUATES!

Nima Ghitani graduated from Meyer Jackson's lab and is now a Postdoctoral Fellow at the National Institutes of Health.

Cliff Rodgers graduated from Robert Pearce's lab.

CONGRATS TO THE STUDENTS THAT HAVE RECENTLY PASSED THEIR PRELIMS!

Chadd Funk	**Antoine Madar**	**Kate Sprecher**
Aditya Rayasam	**Kendra Taylor**	**Ibis Agosto**
Alex Rodriguez	**Matthew Millette**	**Taehee Kim**
Trina Basu	**Rick Wolf**	**Erika Starks**

Image to left: Badger and Gopher football players supported epilepsy reseearch on Nov. 29 by educating fans that 1 in 26 people will develop epilepsy in their lifetime, including Minnesota coach Jerry Kill.

2015 NEUROSCIENCE SYMPOSIUM RECAP

JAN. 15, 2015

BY: MAIA PUJARA (KOENIGS LAB)

After a temporary hiatus since the last Symposium in 2010, the Neuroscience Research Symposium came back in full swing to include a whopping 16 research talks by NTP-affiliated faculty and graduate students, an afternoon poster session, and a keynote speech by a Distinguished Alumnus Lecturer. According to NTP Director Mary Halloran, the symposium stems from a 20-year sponsorship with BTCI. Frank Fan, Director of Research at Promega, spoke to the "high content and high efficiency" of the program for the day.

The fifteen-minute talks were divided up into four sessions covering hot topics in Neuroscience, starting with Plasticity and Development. Faculty members Xinyu Zhao, Marc Wolman, and Reid Alisch showcased cutting-edge research from their labs on protein regulation of neurogenesis in diseases such as Fragile X (Zhao, Department of Neuroscience), gene regulation of habituation learning in zebrafish (Wolman, Department of Zoology), and epigenetic mechanisms underlying anxious temperament (Alisch, Department of Psychiatry). In the final talk for the session, NTP fourth-year student Robert Nichol described his research on the molecular mechanisms underlying axon guidance. His work from the lab of Tim Gomez, shows that the proteins Semaphorin-3A (SEMA3A) and Brain Derived Neur trophic Factor (BDNF) serve as repulsive and attractive agents, respectively, during the axon's growth trajectory during neuronal development.

To finish reading Maia's summary of the symposium and to find infromation on sessions two, three, and four, please follow this link *http://ow.ly/LLj9i.*

Top Image: Alex Rodriguez presenting his poster with his peers. Middle Image: 2015 NTP Distinguished Alum Jeremy Teissere receiving his award from NTP director Mary Halloran and his former mentor, Cindy Czajkowski. Bottom: Trina Basu sharing her poster with Dr. Erik Dent.

2015 Cool Science Image Contest - Winning Image:

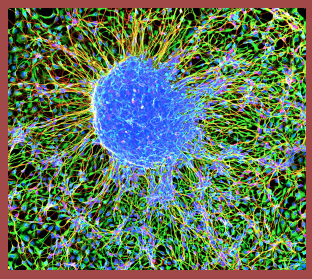


Photo Credit: S.C. Vermilyea (NTP Student), S. Guthrie, T.G. Golos, and M.E. Emborg (NTP Faculty)

This image shows common marmoset monkey embryonic stem cells forming a sphere and transitioning into neurons

CONTRIBUTIONS TO THE PROGAM

Funds given to the program are used to support recruiting activities, guest speakers, the graduate travel award for professional conferences and the annual program picnic. For additional information, please contact the program office at (608) 262-4932. To contribute, please contact the UW Foundation at:

https://www.myuwconnect.org/give?id=9E933A87-82C0-449E-B62E-6476CF0A0A93

Thank you to all those who have contributed and continue to support the Neuroscience Training Program and its students.

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