TECHNOLOGY MONITOR

Indoor navigation, plant-based foods, improved MRI performance and more

The WARF Accelerator Program speeds the development of technologies with exceptional potential for commercial success. With targeted funding and expert advice from seasoned business mentors known as Catalysts, the Accelerator Program helps inventors develop their technologies and advance to the marketplace. The latest developments:

MEDICAL DEVICES AND IN VITRO DIAGNOSTICS

HEARING LOSS:
For many suffering from hearing loss, hearing aids can seem bulky and uncomfortable. The interdisciplinary team of Robert Blick, Max Lagally (materials science) and Burke Richmond (surgery) envision a nanotech-based alternative – an invisible hearing aid placed directly on the ear’s tympanic membrane to improve hearing and sensing capabilities.

The project is on target to build a nanomembrane prototype and demonstrate that it can excite sound waves on the eardrum. To complement their technical efforts, the trio has connected with the UW Business School to help refine their market strategy and determine the major design features of the prototype.

CLEAN TECH
SCALE UP:
A plant-derived solvent called GVL can break apart biomass and unlock the valuable sugars within. The GVL-based process is greener and potentially more affordable than other conversion methods that rely on harsh chemicals and costly enzyme cocktails. But is it commercially viable?

A project led by Dan Klingenberg (chemical and biological engineering) is designing an expanded reactor system to determine if the chemistry is continuous and scalable. Since the last update, the team has made “significant progress” on the reactor – enabling greater speeds and torque – and have successfully run a variety of biomass feeds. Looking ahead, additional modifications will support a wider variety of biomass materials and compositions.

RESEARCH TOOL:
A team helmed by Mike Sussman (biochemistry) and J. Leon Shohet (electrical and computer engineering) is advancing a powerful new analytical method that could make a splash in the research tool sector as well as enable biopharma research discovery. Their method includes short bursts of plasma, followed by mass spectrometry, to study the 3-D structure and solvent accessibility of biological molecules. This work could open a faster and easier route to developing protein therapies.

Several students from the research team participated in the NSF I-Corps program based in Washington, D.C. The experience has helped the team take a customer-first approach and build a business model laser-focused on commercialization.

More tech updates on page 4 >
In infamy, few crop diseases rival late blight. It starved one million people and displaced a million more when it ravaged Ireland’s potato fields in the 1840s. More recently, it struck Bangladesh.

“Late blight continues to be a significant problem in potato and tomato production globally,” says Amanda Gevens, associate professor and extension plant pathologist. “Wisconsin ranks third in the nation in potato production. Our growers are greatly concerned with the risk of late blight in their crop.”

“People still go hungry because of this disease,” adds Katie Gold, a Ph.D. candidate in plant pathology and master’s student in biometry.

Late blight is caused by the water mold Phytophthora infestans. It destroys the foliage above ground while degrading the tubers below. Highly contagious, it is also dreadfully efficient.

“If you get initial spores on a Friday and have rain all weekend, by Monday morning your field could be halfway destroyed,” Gold says.

With WARF Accelerator support, their team is advancing a new diagnostic approach capable of ‘seeing’ the disease earlier than ever before.

Their project employs hyperspectral imaging – measuring narrow wavelengths of light beyond the near infrared – to identify an infected plant before it develops symptoms visible to the human eye.

Gevens, who is co-interim director of the Seed Potato Certification program, has led efforts at competitively funding the project and supporting her student through funding and mentoring.

The third collaborator is Phil Townsend, professor of forest and wildlife ecology, who has contributed technical and analytical expertise as well as mentoring in remote sensing.

Together, the trio has driven the project to the cutting edge.

To explain, Townsend likens a diseased plant to a person with the flu. In both cases, the infection has already taken hold before the telltale symptoms manifest.

But on the molecular level, changes are taking place. Simply stated, sick plant cells react to light differently.

“The key is we are not detecting disease,” says Townsend, who directs the environmental spectroscopy lab on campus. “We are detecting what the disease is doing to the plant.”

By tracking these changes, they have developed computer models that describe how an infection unfolds through time.

And when it comes to treating crops, timing is everything.

“Early detection is a game-changer,” Gold says, because swift intervention can save a harvest. “Even just a couple days’ notice is a huge game-changer for growers.”

Gevens says that the inspiration for the project arose from these very growers, who know that an outbreak of late blight would be devastating to the state’s 64,000 acres of potatoes.
Patrick Sajbel grew up in Wisconsin paper country. Now he stands on the cusp of the bioeconomy.

**WARF:** At its core your company is looking to ancient life to solve a modern challenge.

PS: LanzaTech’s process uses microbes (acetogens) that grow on gases rather than sugars, as in traditional fermentation. The process is one of the oldest biological reactions on earth—predating cyanobacteria or algae. Ethanol is produced naturally as a part of this process.

Emissions from many industries, including steel manufacturing, are very similar to the gases these microbes grow on in extreme environments like hydrothermal vents in nature.

W: Is that why the company is viewed as so novel?

PS: That is one of the reasons. The reactor technology is also novel. The production platform of different types of chemicals beyond ethanol is the area that really differentiates.

We’ll have the first commercial unit on stream in China this year. With startups there is high risk, high reward and it’s a good time to do it. How will it end up? The first thing is to show it – and de-risk it – commercially, and that is where the focus is right now.


PS: Since 2011, Virgin Atlantic has collaborated with LanzaTech and they are committed to pioneering a low carbon aviation future by becoming the first airline to use LanzaTech fuel on commercial flights. Something we’ve done at the pilot/demo level is synthetic jet fuel. It is a long time in development because the standards are extremely rigorous. You don’t want something to go wrong with jet fuel – to freeze or evaporate in flight.

And what about the economics? Air traffic is projected to take off exponentially. You can have an electric car but you can’t make an electric airplane. You still need liquid fuel and low-carbon production will become critical.

W: How do you make the sell to established industries to modify their processes?

PS: It’s a good value-add because you are making a liquid product from a waste gas that is usually burned, sending CO2 out a stack. But you have to create a cross-industry kind of marriage between older industries – steel mills, refineries, other point sources – and a biological process of fermentation.

I’m dealing with people who are experts in their area but they know very little about what I’m doing, so I have to bring them up from zero to 60 pretty fast. And, conversely, I have to listen very carefully to what they say. It’s an interesting exercise in communication.

W: What resonates about the Accelerator Program?

PS: It’s about giving back. Technology delivery is what I’ve done for my career and this is one of the steps in that. It’s just a perfect fit from the standpoint of being able to interact with innovative researchers and set courses to implementation. And I love Madison.

W: What’s the best part of the program?

PS: Interacting across disciplines is a lot of fun.

W: You’ve worked in energy for decades. What’s the future of your field?

PS: Greener. When I was a student, people said if only solar or wind was a little cheaper it would have a greater share of the total energy pool. Economics are now favoring these renewables and the carbon issues are also really forcing that. There is a lot more energy from fossil fuel now, but in the long term that will change. It is a question of how fast.

W: Do policymakers get it?

PS: The pendulum swings. The other day I was on the phone to Abu Dhabi. They realize that the oil economy isn’t going to last forever. There are projections for peak demand, and what do they do after that? So there are plans to expand and send out finished products rather than crude oil, and lowering carbon footprint with renewables.

W: Your work has taken you around the world. What’s the key to communication?

PS: Having a common goal, communicating value to somebody – that is the best part of technology delivery. I was a geography nut since I was a young kid and I love a good exchange.

Enjoying a good meal with people is one of the most important things. If you can eat and joke with each other the other things you have to talk about are easier to handle.
COMPUTER SCIENCE AND ENGINEERING
POWER PACKED:
Reporting “outstanding experimental results,” Dan Ludois (electrical and computer engineering) recently wrapped up Phase II of a potentially groundbreaking project. He is building a redesigned inductance - capacitance filter (referred to by industry as an LC filter) in the form of a single element combining the inductor and capacitor.
This work is important because LC filters help smooth and ‘clean up’ the power from the power supply to the power grid. Ludois’ technology will allow power electronic circuits to become more power dense and cost efficient by integrating the components together (i.e., passive components up to 50 percent smaller and significantly lighter). This could have a major impact in the automotive, aerospace and renewable energy industries as they trend toward lighter, smaller and more efficient components.

PROTOTYPE PROGRESS:
Akbar Sayeed’s team (electrical and computer engineering) continues to make strides designing and building a hybrid analog-digital transceiver system that can dramatically improve wireless communications. Dubbed CAP MIMO, the system boosts data capacity, power and bandwidth efficiency. A recent modification significantly increases the operational range of their 28 GHz prototype, possibly by a factor of three.

Sayeed notes that interest in mmW technology continues to grow as leading service providers such as Verizon and AT&T publish positive results from pre-commercialization testing. His team continues to pursue commercialization opportunities and is exploring possible partnerships.

FOOD AND AGRICULTURE
COLOR CHALLENGE:
The market for plant-based burger and other meat substitutes continues to rise, but like meat, preserving an appetizing red/pink color is key to consumer demand. Mark Richards and Sofia Erazo-Castrejon (animal sciences) are examining strategies to stabilize the color and lipid oxidation of meat substitutes containing plant hemoglobin. They hope to keep these foods from turning brown so quickly under commercial storage conditions.

ACCELERATOR CHRONICLE …continued from page 2
Over the last two years, the team has established proof-of-concept using handheld spectrometers on the ground level. When the disease pops up somewhere in the state, Gold hops in the car with Townsend’s crew to investigate (she calls this “tornado chasing”).
Their next phase is field validation. Their models will be put to the test this summer when a larger, full-range imaging spectrometer is mounted on an aircraft and flown over an infected field in Michigan. The instrument was funded by a UW2020 grant with WARF support, and is one of the few in the nation.
The trial will be conducted under highly regulated conditions. It will take place out of state because Wisconsin law prohibits field testing on late blight.
“Part of the validation is making sure there is no cross-diagnostic; that this is specific to late blight and not identifying some other disease response,” says Gevens.

Once refined, the data could be applied and deployed in several forms, such as software for drone-mounted field monitoring.
It wouldn’t be cheap or simple for a grower to use on his/her own, but the team can envision a contract-type service. Down the line, Gevens says that additional disease and crop information could be integrated in a comprehensive “potato health package.”
There is another major benefit to this work – it potentially takes human contamination out of the equation.
“When an inspector walks through a field you become a vector and create further spread,” says Gevens. “This technology could really advance our clean seed efforts.”
For Townsend, the strength of the project is its cross-disciplinary nature.
“This work is important for the people of Wisconsin,” he says.
“It just makes sense that we come together to address these questions.”

WARF supports a pipeline of promising projects in an effort to accelerate the public benefits of technologies developed in university laboratories.
Visit warf.org/pipeline to see a list highlighting the Accelerator Program’s projects in medical devices, biopharmaceuticals, computer-related sciences and other fields.

For more information about available WARF technologies, please contact the technology commercialization team at licensing@warf.org.
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