TECHNOLOGY MONITOR

Small molecules take on big disease, aquaculture thrives, good news for air quality 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.

BIPHARMACEUTICALS

GOOD NEWS ON BAD CHOLESTEROL:
Cardiovascular diseases remain the number one cause of death globally, and lowering cholesterol has the highest market share among all pharmaceuticals. While statins (e.g., Lipitor) are still the blockbuster drug of choice, about one in five patients cannot achieve the desired results due to side effects.

For these patients, the collaboration of Weiping Tang (pharmacy), Alan Attie and Mark Keller (biochemistry) could one day be lifesaving. The team is synthesizing and testing small molecule secretion inhibitors of a protein called PCSK9. They recently completed pharmacokinetic studies of several of the compounds in mice, and have advanced to the next stage of in vivo efficacy studies.

CLEAN TECH
CRYSTAL DETECTION:
From paint thinners to car exhaust, volatile organic compounds (VOCs) are released into our air every day. Prolonged exposure to these polluting fumes, especially in the workplace, can cause serious health problems like liver damage. But Nick Abbott (chemical and biological engineering) is developing a new and improved detector based on blue phase liquid crystals. He has found that the liquid crystals can detect VOCs in concentrations relevant to OSHA exposure limits. Next up: expanding their temperature window.

SUSTAINABLE SCALE-UP:
In one of the most exciting recent developments in the field, UW–Madison researchers have shown that they can break apart biomass and unlock the valuable sugars within using a plant-derived solvent called GVL. The GVL-based process is greener and potentially more affordable than other conversion methods that rely on harsh chemicals and costly enzyme cocktails.

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Entrepreneur and self-described “tinkerer” Dan Ludois is building the nuts and bolts of a revolution.

For being audaciously young, Dan Ludois has an appreciation for history.

In his office in Engineering Hall, a poster of Nikola Tesla broods beside a Ghostbusters-inspired proton pack. Antique batteries share shelf space with handmade prototypes of his inventions. Part of a motor he patented as a grad student sits next to one of Thomas Edison’s.

“For more than 100 years the basic recipe of electric motors hasn’t changed,” he explains. “It is a hunk of steel with copper coils inside. We’ve added rare earth magnets now, but the idea is the same.”

“My quest is to do a fundamental materials change in how we manage our electric power.”

Ludois’ war on conventional wisdom has taken several fronts. Most days find him on campus, teaching and running a lab as an assistant professor of electrical engineering. He’s also one of the brains behind a buzzy young startup called C-Motive Technologies, located on the east side of Madison next to the shuttered Oscar Mayer plant.

The common theme of his work is “capacitive” power conversion. In other words, harnessing nature’s electric fields to transfer electricity rather than running current through wires.

Ludois, who hails from small towns in southern Wisconsin, brings fresh eyes to old problems. His latest Accelerator project is a good illustration. His team is building a so-called integrated inductor/capacitor. In essence, they are taking two fundamental electrical components and putting them together in the same volume.

It sounds deceptively simple, but no one has done it quite like Ludois. His design cuts size, weight and cost. And most interestingly, it streamlines production because both components can be manufactured simultaneously using existing techniques.

Originally, Ludois intended his device for battery pack boost converters in electric vehicles. But talks with industry have led him to pivot. He now believes the hottest market could be protective filters for use with state-of-the-art wide bandgap semiconductors.

“These new semiconductors are going to be at the heart of all major power conversion efforts from cars to wind power,” he says. “There has been a lot of focus from the Department of Energy.”

Ludois understands the road from idea to adoption is steep. Countless early-stage technologies have foundered in the “valley of death” between university and industry. WARF support can be something of a lifeline.

“The Accelerator Program is helping us close the gap,” he says. “We’re now into the fun part of the work. We know the concept is sound. We’re tweaking and adjusting and refining to get it into a form factor – a package that is attractive to a manufacturer.”

He’s no stranger to the private sector. In 2012, Ludois and two co-founders – all newly minted UW grads – launched C-Motive to continue pursuing their dream of super light, recyclable electric motors. No copper, steel or rare earth materials, which are an environmental nightmare.

The students had developed a pair of inventions on their own, independent of the UW. Looking for a “safety net” they elected to approach WARF.

“A piece of IP is only as good as your ability to enforce it,” Ludois has said.

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The Leading Edge
Curious Mind

Rich Schifreen – scientist, CEO, adventurer – helmed WARF’s Accelerator Program for five years. Upon his retirement in February he sat down to reflect on the program he helped craft into an innovation powerhouse.

WARF: In 2011 you were tapped to become the AP’s first dedicated manager. What did you bring to the role?

RS: If you look at my background I have been everything from a bench chemist to an R&D director. On the business side I have been everything from a sales rep to a CEO. That experience gives me a different perspective.

As AP manager, one of the first things that I did was go back to the Board of Trustees, WARF leadership and the Catalysts and ask, what is an appropriate metric for us? We shifted from ROI [return on investment] to licensing. We felt that is what we do.

If we position a technology properly and develop it properly, and we’re lucky and Mother Nature cooperates – which doesn’t always happen – the outcome for us is a license. Fundamentally, it is the licensee that has to make the technology commercially successful. Hopefully we’ve done a good job of finding a licensee that can take it forward.

W: During your tenure you oversaw development of 80 of the most compelling, commercially promising projects from neuroscience to supercomputing. What made you successful?

RS: To me, the diversity was part of the fun. I like new things – I don’t like to keep doing what I can already do. I have always gravitated towards new business, towards taking new technology and turning it into products. To be successful in this role you have to intimately understand how that happens.

W: What would be your advice to your successor?

RS: The biggest success factor is understanding both academia and industry and how they interact.

W: And sometimes make tough calls.

RS: Experiments can fail in the lab. That’s just the world we live in and that’s fine. What I look for is communication. We’ve tried to build in checkpoints, milestones, control mechanisms.

We know that every year our patent portfolio ages it has less worth to us. Depending on the field that may have a big effect or not. But there is competition out there. Probably every single project has competitors both in industry and from other universities. It’s a race.

W: What would you like to see from the program going forward?

RS: Our Catalysts are a phenomenal group of people. I wish we could have more of their time, more of them involved in a more intimate way with the investigators. That can mean rolling up their sleeves and helping us license to an existing company through their contacts or helping to form a startup. We have had a couple wins there. Some of our Catalysts are venture capitalists so they may help us with strategies to obtain funding. Or they may be in a company with an interest and resources to collaborate.

W: Is our location and business ecosystem part of the challenge?

RS: To me, that is the biggest challenge. In two models we looked at, San Diego and Austin, they have a network of hundreds of people with the right qualifications who are local. That is our limitation—having the really knowledgeable, talented business people in the community who want to work with PIs on a technology. Occasionally we have a hit that works out really well, like Mark Cook and Ab E Discovery, but it can be an uphill battle.

W: Does any particular project or success story stand out?

RS: We had a clean tech project looking at extracting fermentable sugars as a feedstock to produce bioethanol from agricultural waste. The investigator was exploring lithium salt as the reagent. The Catalysts raised some red flags around using lithium. We went out and found an expert on lithium supply chains. What we determined was, if we set up a modest plant, say, a hundred million gallons of fermented ethanol per year and were able to recycle this lithium reagent with 95+ percent efficiency, we would use about 20 percent of the world’s supply every year. And by the way, we are competing with lithium ion batteries.

It became clear that lithium scientifically might work, but from a commercial standpoint was a non-starter. Our investigator started looking at other things and found that a calcium-based reagent would work almost as well and be readily available and much less expensive. So we compromised. He took both through his experimental process. He got his lithium publication and we demonstrated feasibility for the calcium reagent.

It was a win-win. An example of managing a project that had commercial goals and research goals.

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To take the next step, a team led by Daniel Klingenberg (chemical and biological engineering) is designing an expanded reactor system to demonstrate that the chemistry is continuous and scalable. This information is critical to establishing the commercial viability of the process. Klingenberg is joined in the project by Thatcher Root, Troy Runge, Tim Scott and Carl Houtman.

**COMPUTER SCIENCE AND ENGINEERING**

**STARTUP NEWS:**
Startup news: SimpleMachines Inc. is commercializing a microprocessor-based solution for accelerating Cloud intensive computation. The technology, called Proximate and designed by Karu Sankaralingam, offers unrivaled processing speed (up to 100x faster), significant energy savings and a rapid deployment path (ease of programming and simplified integration) when compared to existing solutions.

In an exciting development, Sankaralingam and his startup team recently closed a seed round of fundraising, with commitments from multiple individual and group investors. Stay tuned.

**MEDICAL DEVICES AND IN VITRO DIAGNOSTICS**

Perivascular platform: More than half a million open surgical procedures, including bypass, take place in the U.S. every year. A dangerous narrowing of the blood vessels—a condition called vascular stenosis—often occurs after surgery. Presently, there is no drug delivery method clinically available to treat this potentially life-threatening complication.

A collaboration between Lian-Wang Guo (surgery) and Bill Murphy (biomedical engineering) aims to meet this urgent clinical need. They are developing and testing drug-loaded polymer sheaths as a delivery platform for preventing stenosis. Trials in pigs (which closely resemble human physiology) are ongoing and so far extremely promising. The team is exploring commercialization options, including forming a startup.

**ACCELERATOR CHRONICLE**

“My personal view was that, even if we failed, at least our technology wouldn’t disappear into the ether. It would still be in the hands of someone who could potentially carry the licensing torch and go forward.”

Instead of failure they found a partner ready to help, and bagged a WARF Innovation Award in the process. They were off and running, starting out in a spare bedroom before stints in Sector67 and the MGE Innovation Center. C-Motive currently has five employees.

Ludois has stayed involved with the company as chief science officer, even after accepting a faculty position at the university.

To Ludois, the Wisconsin Idea is more than a history lesson. He’s living it.

“I’m harnessing the fundamental brain power of the university to create something new,” he reflects. “I’m using my startup with all proper channels to take the idea and push it forward such that industry on local and global scales can adopt it.”