Heal thyself

OSU SPINOFF NANOFLBER SOLUTIONS

& likely to get steady revenue supplying labs, but its dreams lie in patients regrowing their own damaged tissue—including for surgeries at Ohio State.

BY CAIRIE CHILOE | ACTION/SHOOT

The CEO has a long history in IT startups. The lead inventor is an engineer specializing in polymers. Connected through cross-disciplinary efforts at Ohio State University, they re-building a company in a futuristic field of medicine.

Even before hitting the market, they were making international headlines. Nanofiber Solutions LLC in the TechColumbus incubator is set to start production in July of lab dishes and microscope slides laced with custom-made ultra-thin filters that researchers say work better than formless gel for growing cells.

But a surgeon’s urgent plea last year catapulted the company from lab bench to human body in just one year. Nanofiber Solutions built an artificial trachea implanted in a patient, whose body populated it with cells and grew blood vessels into it, providing the best possible proof that the main product line is cell-friendly.

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TISSUE ON DEMAND: Field expected to ‘explode,’ hit $5B market value

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That procedure was in Sweden, but the company is working with Ohio State's month-old Center for Regenerative Medicine and Cell Based Therapies to bring tissue-replacement surgery to Wexner Medical Center.

"It's a perfect fit we have here. An OSU spinoff company circular back to OSU to help treat their patients," said Ned Johnson, the company's chief technology officer.

Nanofiber Solutions is the latest entry into the field of regenerative medicine, using stem cells to help the body grow its own replacement tissues in a broad range of disease and injury. The global market for replacement tissue is estimated to reach as high as $5 billion by 2014, said Tony Dennis, CEO of BioOhio.

Researchers must team up with private businesses if they want their discoveries to help society, said Chandon See, the regenerative center's director.

"This field of so-called 'tissue on demand' is about to explode," See said. "If we emphasize academic-private partnerships, not only will we save lives, but this could usher in a new era of the economy that will be driven by tissue engineering."

Nanofiber CEO Ross Kaushal predicts his lab product sales could hit $300 million this year and as much as $1 billion next year.

Kaushal said he left the software industry for a medical start-up because of the rare chance to work with technology practical solutions in use or scope. Nanofiber's electrospun fibers, 100 times thinner than human hair, can be used for cell research, to grow algae for biobeds, or as a "starting point" for cell-stem cells to regrow blood vessels, intestines, cartilage, bone, skin or someday even complete organs.

"The body is growing the organs; we're not growing anything," Kaushal said.

Nanofiber has raised $1.1 million since start-up operations in 2010, when Johnson graduated. More than half was non-dilutive federal and state grants, plus a $500,000 TechColumbus investment that can convert to an equity stake in future investment rounds.

The company has five employees, and Kaushal hopes to expand to 10 workers in about a year when the company can move out of the 8,000-square-foot lab.

HOW IT STARTED, HOW IT WORKS
Johnson started the company in 2006. His Ohio State in-state graduate student in materials science—a biointerfacing engineer—was studying the properties of metals, plastics, glass and other materials when the department got a request from Mariano Vipiana, Nobel laureate professor of neurosurgery who studies brain cancer at the University of Chicago.

Brain tumors are deadly because they way they wrap around microscopically thin neural cells, climbing them like jungle vines to spread through the brain. Tumor cells just sit there in a gel-filled Petri dish.

He needed a medium that mimicked the natural habitat to see if drugs would stop them from spreading.

Johnson, working under faculty adviser John Lampi of Nanofiber Solutions' co-founder although he remains at Ohio State, came up with a process to make a fabric that fits to dishes and microscopes.

Broadly, it involves dissolving the same type of polymer used in soda bottles and ejecting it from needles while applying high voltage—but Johnson's patented technique allows him to control how the fibers line up—so he can customize the direction and weave of the fibers to mimic microbacterial, lung, heart muscle or other tissues.

The lab's duct-taped equipment bears deposits from市中心 plastic streams.

"It's very hard to do, and that's why you don't see other electrospun organs out there," Johnson said.

Vipiana said cancer cells behave on the fibers like they do in the brain but are easier to observe because they're on a plate that can be inserted in a microscope—allowing his experiments flexibility and speed. It's also easier to grow huge numbers of cells to test gene expression.

"It has a significant edge over other models in the market," he said. "It's a huge versatility that few labs have, to use multidimensional conditions."

Soon Johnson was fielding requests from a dozen labs across campus.

"We figured if there are this many people...

It's a perfect fit we have here.

An OSU spinoff company circular back to OSU to help treat their patients.

IN AN URGENT CALL

In 2011, as the two completed the lab product line, a request from a surgeon in Sweden helped lead to the future they'd expected would take years—making replacement tissues.

A Baltimore man with a tumor in his trachea was going to die without a new windpipe, so Dr. Paulo Macchiarini of Karolinska Institute in Stockholm asked if Nanofiber Solutions could make one. Instead of spinning the tiny fibers into a flat fabric, they almost formed a metal form, building a stiff but spongy scaffold with plenty of spaces for cells to move in.

The patient's stem cells were introduced to the plastic two days before the operation last November. Macchiarini had done a similar surgery with a different material, and said in an email to Columbus Business First that he turned to the Columbus company because "I thought that we would need to mimic nature as close as possible to get the best outcome."

"In plain English, the cells like it and the body likes it, so the chances of successful replacement is greater," said Dennis of BioOhio.

Johnson and Macchiarini declined to discuss medical records, but news outlets that interviewed the patient after recovering reported he died four months later.

Next, the company is making a trachea for a toddler born without one. The child's family is raising money online for Macchiarini to operate Russian doctors plan two other tissue surgeries this June.

Several companies, including MedinCor and Medtronic, are working on grafts for patients who need replacements.

"Our hope is this will be a medical device available off the shelf," Johnson said. "Ideally, it could be used before a patient has gone through cell-killing chemotherapy and radiation, he said.

The university will receive licensing income from Nanofiber. The school has invested millions of dollars the last two years to improve its lagging performance in economic development from spinoffs.

"There are a lot of good ideas at Ohio State," Johnson said. "It's not the mindset of academics to start companies. (But) I don't like teaching, I don't like writing grants. What's the point of doing science if it doesn't help anyone?"

614-236-4561 tjohns@osu.edu