'AIM-ing' Up: RIT Student-Researchers Help Build the Photonics Ecosystem

Rochester is making an impact in photonics manufacturing, and RIT is playing a central role as a key partner in the American Institute for Manufacturing Integrated Photonics (AIM Photonics), a national manufacturing initiative expected to stimulate economic development and global competitiveness.

Photo credit: RIT.edu

Sanjna Lakshminarayanamurthy (l), Tayler Swanson and Thomas Kilmer discuss building prototype photonic devices in a course about manufacturing photonics manufacturing processes. It will be one of the first modules for workforce development programming through the AIM Academy, the educational arm of AIM Photonics.

Photonics is an intricate science about harnessing the power of light. RIT's numerous experts are contributing to photonic device manufacturing, industry assessment to improve workforce training and education, and device packaging and assembly solutions - all critical areas necessary for the growing photonics ecosystem.

RIT students are a big part of that system and are directly involved in the AIM Photonics program, creating photonics devices and solutions in classes and via research projects designed to become foundational materials to help train others for an industry expected to transform manufacturing.

These students work alongside faculty-researchers developing photonic devices and electronic packaging solutions for the national manufacturing initiative, which was launched in June 2011 by the Obama Administration, ***obamawhitehouse.archives.gov/the-press-office/2012/07/17/fact-sheet-white-house-advanced-manufacturing-initiatives-drive-innovati*** and ***obamawhitehouse.archives.gov/the-press-office/2011/06/24/president-obama-launches-advanced-manufacturing-partnership.***

Called the Advanced Manufacturing Partnership (AMP), this national effort was designed to bring together industry, universities and the federal government to invest in the emerging technologies and skills that will support a dynamic domestic advanced manufacturing sector in order to create high-quality jobs and to encourage companies to invest in the U.S.

AIM Photonics is part of the federal government's National Network for Manufacturing Innovation. Created in July 2015, it's run by a consortium of 90 university, government and corporate partners, led by SUNY Polytechnic, RIT, University of Rochester and MIT.

Specifically, RIT students are involved in the following:

- Developing some of the first prototype photonic integrated circuits.
- Writing these process steps for fabricating the chips for the AIM curriculum.
- Researching the available fiber attachment solutions needed for production of the new devices.

"Photonics is the future," says Sanjna Lakshminarayanamurthy, a microelectronic engineering graduate student from India. "I do live in the present, but we need to have an eye for the future. I know I can contribute; I felt this work would bring out the best in me."

Lakshminarayanamurthy was one of 20 students taking Photonic Integrated Circuits, an upper-level course, delivered by Stefan Preble, associate professor of microsystems engineering in RIT's Kate Gleason College of Engineering, and several other faculty members.

Focused on learning the overall photonics manufacturing process, students designed a

prototype photonics chip where laser light is precision-placed onto silicon.

"All of the courses I took in microelectronics helped me in the clean room to work on this project. We tried different chemistries we had not used here before," she says. "Silicon photonics is just growing, and it can be compatible with the existing integrated circuit process."

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In addition, Lakshminarayanamurthy helped define the preparation, etching steps and processing necessary to fabricate chips. Her project information is being integrated into the curriculum RIT began to develop for AIM Academy. She went on to apply this knowledge in her post as a process engineer at GLOBALFOUNDRIES in Albany, NY.

Once an optical fiber is aligned to a feature on silicon, the challenge becomes holding that fiber in place, protecting it during testing before packaging and assembly. Keyla Bastardo-Ramirez works closely with Martin Anslem, director of the Center for Electronics Manufacturing and Assembly, to produce solutions that ensure manufacturing processes are efficient, cost-effective and sustainable.

Her literature review on fiber attachment challenges, current solutions and those being developed is extensive. It also highlights the need to develop novel research programs that can eventually bridge the gap for adopting photonics integration technology in high-volume production applications, she explains.

"When I started my master's degree in manufacturing and mechanical system integration, I already had experience working in manufacturing firms, not in the electronics industry, but I was already fascinated with manufacturing processes of any kind," says Bastardo-Ramirez, who is from Santo Domingo, Dominican Republic.

"I would like to continue working on developing this technology in industry or in academia."

Industry welcomes students such as Bastardo-Ramirez, who has since entered the photonics workforce after graduating from RIT. Other workforce needs - from entry-level positions to research and development - are being assessed via the Photonics and Optics Workforce Education Research (POWER) group, founded by Ben Wick and Kelly Martin, both assistant professors in RIT's colleges of Science and Liberal Arts, respectively.

POWER's research is focused on skills needed for photonics and optics; the group explores how academia and industry define, perceive, influence and value STEM workforce development.

Alexandria Cervantes, an undergraduate on one of several projects within the research group, did in-depth interviews with managers and new hires from local companies, as well as graduate research assistants at universities.

Preliminary data revealed that supplementing current technical coursework with communications and interpersonal skills could benefit all students in STEM programs to better prepare them for success in their respective fields.

Cervantes' study was part of the Research Experiences for Undergraduates, where undergraduates from RIT and other national universities can apply for directed projects related to their degree programs and interests. Her work, titled, *Values and Perception of Communication in Photonics and Optics*, was featured in an Undergraduate Research Symposium, where she presents the data. It was also becoming part of POWER's contribution to AIM's comprehensive workforce needs assessment studies.

Photo credit: RIT.edu

Alexandria Cervantes presents research about communication skills needed in the photonics and optics industry at the Undergraduate Research Symposium.

RIT students are involved in many more projects related to photonics technology and education, and their work will reap dividends, not only for AIM Photonics, but also for their own careers, notes the university.

Specifically, RIT's photonics connections include several multidisciplinary research labs and project teams:

- **Future Photon Initiative: *rit.edu/fpi***
- **Integrated Photonics Laboratory: *rit.edu/nanophotonics***
- **Center for Electronics Packaging and Assembly: *rit.edu/cema***
- **Photonics and Optics Workforce Education Research: *rit.edu/power***

AIM Photonics is one highlight of RIT's graduate engineering programs, which recently received a high ranking for its programs on campus and online by *U.S. News & World Report,* notes the university.

Additional graduate programming at RIT includes immersions in artificial intelligence (AI), tissue engineering, microelectronic engineering and 3D printing materials sciences. More information about these programs can be found at ***rit.edu***. You can also find graduate student stories that highlight the work being done and how it has enabled these students to go on to careers where they are making an impact at such companies and organizations as NASA, Apple, IBM and SpaceX, adds RIT.

Clarkson University Receives $75,000 EPA Grant for Food Waste Project

Clarkson University recently received a $75,000 People, Prosperity and the Planet (P3) grant from the U.S. Environmental Protection Agency (EPA).

The P3 grant is being used by the Potsdam, NY-based university to develop a more efficient ammonia removal and recovery process for food waste digesters to reduce the volume of food waste sent to solid waste landfills, simultaneously addressing the objectives of improving air quality and revitalizing land, according to the EPA.

"These students are applying what they have learned in the classroom to create innovative solutions to environmental challenges," says EPA Administrator Scott Pruitt.

"These awards support the next generation of scientists and engineers in their commitment to environmental protection, while helping states, tribes and local communities find solutions to their environmental issues."

"These P3 students are tackling some of our most pressing and complex environmental issues," adds EPA Regional Administrator Pete Lopez.

"The innovative research funded today will help us better protect human health and the environment."

"We're excited for the Clarkson's P3 student team who are developing innovative food waste solutions to address our most pressing environmental, health and energy questions while educating our future engineers and scientists," says Gina Lee-Glaser, vice president for research and scholarship at Clarkson University.

"Environmental projects like this one give our students the chance to solve real-world, open-ended problems with creativity and risk-taking to obtain solutions that are practical and sustainable."

EPA awarded more than $557,000 in funding nationally for eight student teams via the P3