

Laboratory Learning

Research teaches students about flexibility—in electronics and in life

By Liz Ahlberg

“Fabricating flexible electronics is my thing. I love it!” said Seung Yun “Simone” Heo, her enthusiasm evident even while speaking about the technical processes of metal vapor deposition and electron beam lithography. “We’re making everything from scratch. I can do it myself from step one. It’s not that hard to do, it’s more about time and effort.”

Heo, from Northbrook, Illinois, accomplished all of this as an undergraduate researcher in the lab of materials science and engineering professor John A. Rogers.

While faculty, graduate and postdoctoral researchers contribute greatly to the research excellence that the campus is known for, the U. of I. also offers many opportunities for undergraduate students to be involved in research. The Rogers group is one of the largest, with 20 to 40 or more undergraduate members each semester.

“It’s definitely a lot of commitment, working at a lab while going to classes,” Heo said. “But I would say it was worth it, because I got a lot of unique experience and training. It’s a bridge to applying what I’ve learned in class, from learning the theory to actually doing it.”

Rogers, a Swanlund Chair and the director of the Frederick Seitz Materials Research Laboratory, is a globally renowned pioneer of stretchable, flexible electronic devices. From stick-on medical monitors to less-invasive surgical tools to higher efficiency solar arrays, his lab produces a variety of innovative new devices and techniques for making them.

For Rogers, undergraduate research has a special priority.

“One of my core responsibilities, as an educator, is to give every interested

undergraduate a chance to experience academic research, at an intimate, hands-on level,” Rogers said. “We have many world-class research programs here at Illinois, and we also have some of the best and most dedicated undergraduates. Bringing these two things together, at a large scale, seems like a no-brainer. The result truly enriches the overall experience for our students.”

Rogers’ group includes students from a variety of science and engineering majors, providing opportunities for students not only to apply skills learned in their respective classes but also to collaborate across disciplines. It also exposes students to applied theories and specialized techniques developed in the Rogers lab as they work to integrate solid electronics with soft tissues and flexible surfaces.

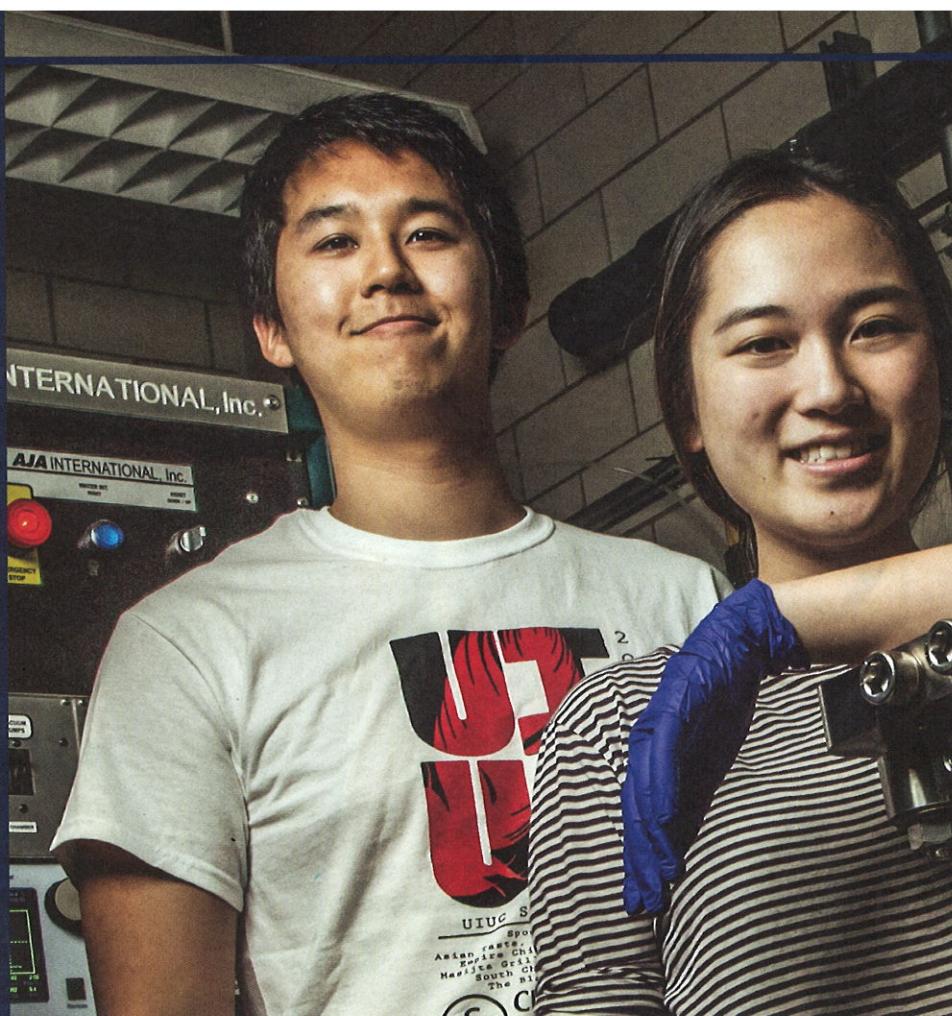
“Conducting transfer printing, which is a process of transferring a device from hard substrate to soft substrate, was a very special experience for me,” said Pauline Joe, a former Rogers group member from Jakarta, Indonesia, who graduated in 2013 with a degree in materials science and engineering. “It is a fascinating technique, which is hard


to imagine just by reading a textbook or learning in the classroom.”

“Techniques I learned in the Rogers group are still guiding some of my research paths now,” said Shawn Mack, who works as a research scientist at the Naval Research Laboratory in Washington, D.C. Mack, who is from Geneva, Illinois, graduated in 2005 with a degree in materials science and engineering. “Participating in research gave a completely different perspective than the classroom since we were trying to create things that didn’t previously exist. Research experience built confidence that I could apply coursework to practical problems.”

Exposure to lab procedures and equipment training not only gives students valuable hands-on experience beyond their coursework, it also hones skills to help them succeed when they enter the workforce or enroll in graduate studies.

“I got to be a part of every process of finishing a research project, from brainstorming ideas to purchasing materials, fabricating devices, installing equipment and writing manuscripts,” said Yei Hwan Jung, a 2011 graduate of electrical





Jonas Kurniawan and Simone Heo received hands-on experience and equipment training as undergraduate researchers in professor John Rogers' lab.

PHOTO: L. BRIAN STAUFFER

and computer engineering and former member of the Rogers group from South Korea, now pursuing a doctorate at the University of Wisconsin at Madison. "When I started my graduate studies, I was already well prepared. I did not have to spend a yearlong training period like the rest of my peers, and I could start on a real funded project immediately."

Undergraduate researchers in the Rogers group are paired with graduate students or postdoctoral mentors. The mentors train the undergraduates to use the equipment and walk them through the research process.

"My mentor taught me how to fabricate, how to document each step, and why we do this," Heo said. "When he writes up his presentations, he explains what to focus on and how to present, and from watching my mentor I know what kind of efforts are required to author a paper in a journal."

Beyond technical training, participating in research as an undergraduate also teaches students valuable life skills applicable to any career path they pursue after graduation.

Joe, who now works as a research scientist at the Massachusetts Institute

of Technology, said, "I am very thankful to professor Rogers for the invaluable opportunities and experiences that taught me to think outside the box, and opportunities to work with various people that led me to look at problems from diverse perspectives."

Jonas Kurniawan, a materials science and engineering student originally from Jakarta, said he has learned perseverance, teamwork, time management, integrity and entrepreneurship through his time with the Rogers group.

"In class, the professor guides you. In the Rogers group, my graduate student mentor gave me an independence where I could investigate my own project," Kurniawan said. "For one device we had the idea to use copper, which is a good conductor, and to coat it with a thin layer of gold, so it doesn't oxidize. Professor Rogers liked the idea, and now it's used throughout the group."

Joe, Jung and Mack all said their decisions to participate in undergraduate research helped to define their trajectory after graduation. For Heo and Kurniawan, both pondering their post-graduation futures,

participation in the Rogers group has given them clearer ideas of their diverging paths. Heo would like to pursue graduate studies and continue in academic research, while Kurniawan is nurturing twin passions for engineering and entrepreneurship.

"I want to do a mix of science and management, being able to understand the engineering side but also the product implementation," Kurniawan said. "This group has inspired me a lot. With these kinds of technologies, if we can make them affordable and reproducible on the large scale, it could make a big difference in countries like where I came from, Indonesia. Illinois provided me with a lot of different opportunities. You can have it all here, as long as you are active in seeking opportunities."

Such statements echo the experience of Rogers himself.

"My own time as an undergraduate researcher left a very strong impression on me, to an extent that it ended up shaping my career trajectory," Rogers said. "Without an undergraduate research experience, I would not be where I am right now."