Developing the Next Generation of Scientific Talent:

ERIN RATCLIFF

Erin Ratcliff studied chemistry, mathematics, and statistics as an undergraduate at St. Olaf College in Minnesota and then completed a doctorate in physical chemistry at Iowa State University. That breadth of knowledge combined with her enthusiasm, drive, and ability to communicate were what convinced Regents Professor Neal Armstrong to offer her a postdoctoral position in his laboratory at the University of Arizona. One of her first tasks there was to help with the application for what became an Energy Frontier Research Center (EFRC), the Center for Interface Science: Solar Electric Materials, focused on thin-film solar cell materials. When the grant came through, Armstrong created a position for Erin as a research scientist for the Center.

Thin-film solar cells have a number of potential advantages:

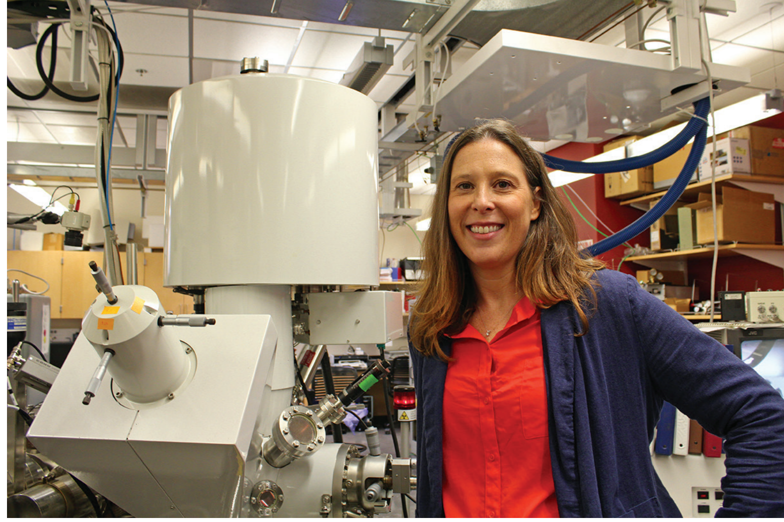
> They are thin, so even multi-layer cells don't require a lot of raw material.

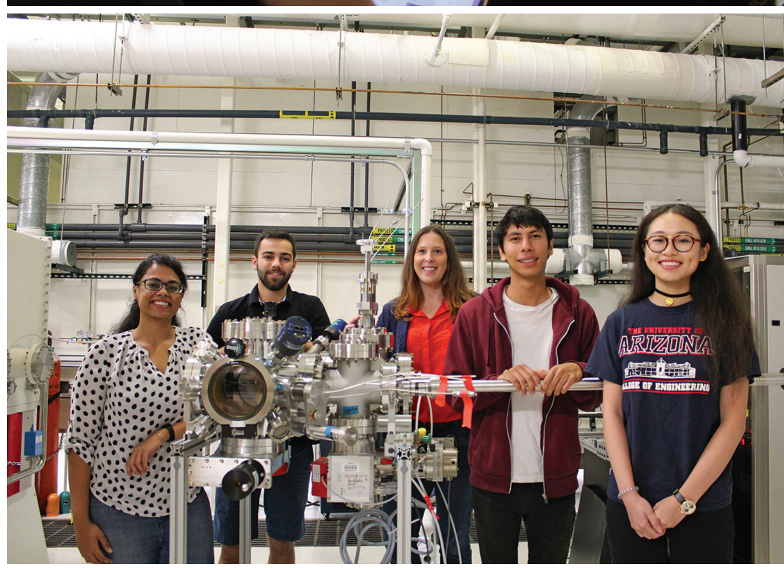
> They lend themselves to manufacture by depositing or "printing" onto glass or other inexpensive structural materials, lowering costs.

> If made of transparent materials, they can both transmit light and generate electricity, potentially enabling "smart" windows and self-powered greenhouses.

A key challenge has been to increase the efficiency with which thin-film cells convert sunlight to electricity, a challenge that depends on understanding the electron transfer mechanisms between the active layers that absorb sunlight (and generate electrons) and the conductors that carry away those charges as electric current. That interaction was the focus of the Center's research.

The Center was a large and geographically diverse team—15 principal investigators at four universities and the National Renewable Energy Laboratory (NREL). Erin quickly became the glue that held the entire effort together. She worked with university scientists to explore potential new





Top: Erin Ratcliff at work in her laboratory at the University of Arizona, where she is a faculty member in the Department of Materials Science and Engineering.

Middle: Ratcliff teaching a class on the basic principles of a solar cell, part of a course on solid state chemistry at the University of Arizona, where she has also become a mentor for women engineering students.

Bottom: Ratcliff and her research team are conducting investigations aimed at developing advanced thin-film solar cells, building on the knowledge she helped to develop under the EFRC grant.

(All photos from University of Arizona College of Engineering)

"Erin became a poster child for cross-disciplinary research, as well as the most prolific scholar of the Center."

—Neal Armstrong, University of Arizona

Professional Affiliations

St. Olaf College

Iowa State University

University of Arizona
Dept. of Materials Science and Engineering

materials and interfaces and with NREL staff to create and test prototype devices in the lab. She developed new measurement techniques to characterize the structure and properties of the materials and measure their interactions. She published joint research with all 15 of the principal investigators, spending a lot of time in their labs.

The diverse team worked productively together. They created both a greater understanding of the interface issues—between two types of materials "that don't want to be together," as Armstrong describes it—and especially of the mysterious sites that formed to recombine opposite charges and thus lower the effective current generated. Creating ways to remove such recombination sites was a key outcome of the research.

The five-year effort led to significant improvements in the efficiency of organic semiconductor thin-film cells, which have now reached 17%. The knowledge and measurement techniques developed have since carried over to inorganic thin-film cells. Companies such a California startup, Next Energy Technologies, are commercializing thin-film solar cells for smart windows that can harvest light from both inside and outside and convert it to electricity, significantly lowering energy consumption in buildings. And Ratcliff's own research is now exploring how such cells might be used for self-powered greenhouses.

The other significant impact of this EFRC was on Erin herself, as she is the first to acknowledge. "The experience was ideal; it gave me a chance to see many different management styles in the different labs and gain a real understanding of what organized, large-scale science can accomplish," Erin says. And following the EFRC, she accepted a tenure-track position in the Department of Materials Science and Engineering at the University of Arizona, where she has already built her own research lab and team and emerged as a mentor of women engineering students. "I had experience I could put to immediate use and 15 senior mentors." Armstrong concurs: "Erin already had strong networking skills when she came to me. But during the EFRC she really matured in her ability to collaborate with and manage both young and established scientists, and in her own capacity as a scientist: she became a poster child for cross-disciplinary work—a key EFRC workforce development goal—as well as the most prolific scholar of the Center."

Center for Interface Science: Solar Electric Materials (CISSEM)
Winner — Workforce Award
www.science.osti.gov/bes/efrc/Centers/CISSEM