

## BIOGRAPHICAL SKETCH



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Dr. Warren is a staff scientist in the High Efficiency Crystalline Photovoltaics group at NREL. Her research is focused on the heteroepitaxy of III-V materials on silicon and other low-cost substrates, nanoimprint lithography, and the simulation and fabrication of high efficiency tandem solar cells and modules. She is interested in understanding how nanoscale surface control can influence the nucleation and coalescence of heteroepitaxial films.

Her work on three-terminal tandem solar cells based on bottom cells with interdigitated back contacts is a compelling platform for tandem cell integration because it enables the same robust performance of individually operated subcells under varying illumination conditions but does not require lateral current extraction between the cells, which can become challenging when scaling devices to large areas.

Warren has worked on a variety of collaborative projects with universities and mentored several graduate students and undergraduate interns, winning multiple mentoring awards. Her prior work at NREL included the photoelectrochemical characterization of new semiconductor materials and the development and testing of solar thermoelectric generators using NREL's High Flux Solar Furnace. Before joining NREL, she completed her PhD at Caltech, studying the growth and energy conversion properties of silicon microwire arrays as well as the electrochemical characterization of semiconductor photocathodes and catalysts for solar fuel generation.

- *What is your job like? A typical day? What are the duties/functions/responsibilities of your job?*

As the PI of several research projects, I spend a large amount of time running meetings with graduate students, postdocs, researcher and technicians both one-on-one and larger team meetings. Also, meetings with management takes a considerable amount of my time. Other activities include answering emails, reviewing and writing papers, and organizing events such as conferences. On the technical side of things, I work whenever I can with an advanced SEM instrument and do solar cell modelling for efficient tandem solar cells.

- *How did you get your job? What jobs and experiences have led you to your present position?*

After finishing my PhD, I thought I would go to industry, but the economy at that time deeply impacted industry and new hiring was very difficult. Through my network, I got an opportunity to work at NREL and Colorado School of Mines as a postdoc on a solar thermoelectric generator project for one year. I

got many opportunities to go to industry after I started my work at NREL but decided to not to and stayed at NREL. Also, my husband started his postdoc at NREL, so that worked out nicely. I applied to other positions within NREL and got a job in the silicon photovoltaic group as a postdoc where I worked very closely with the PI of this group on many projects and other valuable experiences such as writing grants. At the end of my postdoc time, I applied for a staff scientist position at NREL and was hired. It has been almost 10 years since I arrived at NREL after graduation, and I like the balance between applied projects and basic research that national labs offer.

- *How can I evaluate whether or not I have the necessary skills for a position such as yours?*

I think it is very subjective, for example, in industry, there are jobs that would require a PhD degree and maybe some other skills and if you got the job, they would train you to do the work. In case of national labs such as NREL, the needs and the skills set change quickly. For example, in one position we may need a good experience in running a specific equipment, while in another, we may need a general experience in a field like electrochemistry and not necessarily in a specific topic such as batteries. So, there is no specific set of skills that will guarantee a job at NREL. Also, NREL is not a big place and therefore hires for specific projects, but once you here, you can engage in other activities such as writing grants for funding or learning about and mastering analytical techniques that will promote your hiring in NREL in other positions when available. In general, what I like about NREL is that their mission is focused on a clean energy future and mission driven people with passion for energy contribute significantly by proposing new research areas for example. But not everyone needs to be like that - some are doing great work on fundamental things and that is important too. There is no simple answer to that question.

- *What things did you do before you entered this occupation? Which have been most helpful?*

In my opinion, one of the most important things if you want a research career is networking effectively. Working with other scientists from diverse backgrounds of science and engineering that work on the same research issue as you can provide different perspectives and may help you solve a problem. Also, having a network of scientists that don't do exactly what you do can help you bounce ideas or with your papers as a "red team reviewer". As a graduate student, attending graduate seminars of other departments can help building your network with scientists from other disciplines. For example, in my case, when I was a graduate student, I needed help with a specific issue and a geologist that I met through networking helped me with it and I learned a lot from her. So, some social skills are important too.

- *How does a person progress in your field?*

NREL is a pretty flat organization and promotion doesn't happen a lot. Usually, it is tied to the overall aspects of your work such as the size of your project, how much research funding you are managing and how experienced you are in your work. If you are a scientist at NREL, there are couple levels of promotion you can get. You can become a group manager, or a senior research fellow and that is kind of it. We only have about twenty senior research fellows in NREL. Some people prefer management tasks like running a program and become a group manager, and some are just happy doing science as a career, which is far from boring because every few years you have to repropose the work you want to do and you always be doing a "new" science.

- *How is the economy affecting this industry?*

It is a good question. It is definitely related. Almost all my research projects are funded by the government in some capacity. But what had happened with me, which is not always true, is that the government offered some kind of stimulus program that put some money into research, especially that research in renewables supports the US economy. But sometimes research programs may get cut for variety of reasons. For example, if there are economic cuts, we sometimes might cut research in one area. Also, there are private funding offered by companies. For example, a lot of companies are interested in the perovskite project in NREL.

- *What interests you least about the job or creates the most stress?*

I don't know the right answer is. I think giving researchers all the money they need without accountability would be terrible. But also, having no job security and having to write proposal every 6 months to have a job, to be able do any work, would be unsustainable too. So clearly the balance has to be somewhere in the middle. Jobs in national labs are 100% project funded. So, if your project gets cut, technically, you cannot do any work and usually there are ways to figure it out but it can be very hard and that the most stressful thing. However, writing proposals and coming up with new ideas are the parts where new creative work is done. The need of new ideas can push us to think outside the box which can be the most stressful part. However, I think a little stress make the people use their brains and figure out solutions. Also, it can be very stressful with deadlines and extended number of hours working on the proposals. So, finding a balance is a key.

- *What special advice do you have for a student seeking to qualify for this position?*

I think the best thing is to look for a postdoc position in a national lab. Also, look for postdoc fellowships in different research labs. It is not required to be in a national lab, but it would be a great opportunity to get to know how work goes in a national lab. National labs usually have many positions for postdoc. Another advice is to include a cover letter with your CV when you apply for a position. A cover letter may fill any holes in your CV and answer questions that might come up such as why you used a specific method or how your experience would meet the specific qualifications needed for the position you are applying for. Take your time to write a one-page letter to promote yourself. It is important to remember that you will not get every job that you apply for and that is fine. NREL also offer programs such as career day that can help in recruiting PhD students and postdocs.