

Interview with Dr. Svitlana Pylypenko

BY MADDY HOFFMANN

Dr. Pylypenko has been a faculty member at Colorado School of Mines for over 13 years. Originally from Ukraine, she has studied at the Kyiv Polytechnic Institute, Kent State University, and the University of New Mexico where she received her Ph.D. in Chemistry. She is currently a professor and researcher in the Chemistry department here at Mines studying surfaces and interfaces of functional materials. Her group focuses largely on researching fuel cells and electrolyzers; these two complementary technologies are critical to our renewable energy future.



MH What sparked your interest in chemistry and the research you do now?

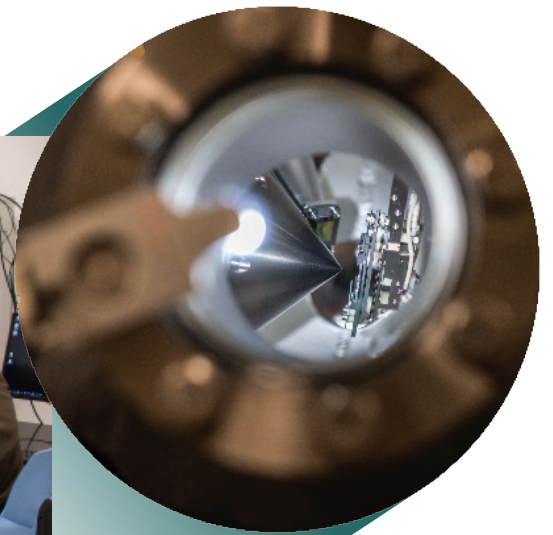
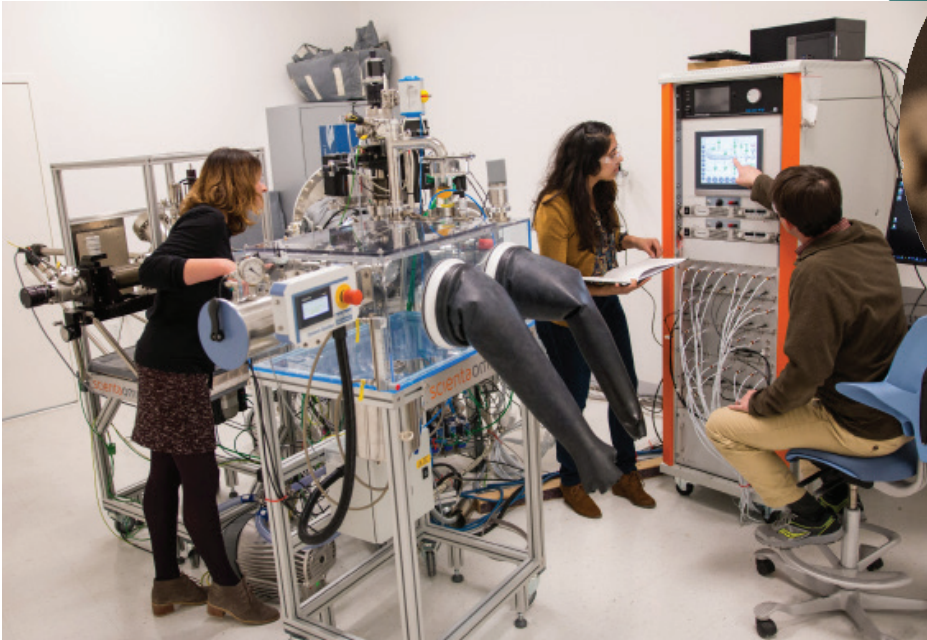
SP I got my B.S. and M.S. degrees from a technical university in Ukraine, from the chemistry and chemical engineering department with a large focus on applied chemistry. However, I did not realize I was an applied chemist until later in my life. I am still focused on applied chemistry and that's what geared me towards an applied chemistry department like the one we have here at Mines.

When I was finishing my Master's degree in Ukraine, it just so happened that a friend of a friend applied to grad school in the US, and then my best friend also joined the same college. After her first semester at Kent State University, visiting over the winter break, my friend convinced me to apply to the grad school. At

that time I didn't really see myself changing my life in such a dramatic way and moving to a different country and being so far from family. But I put together my application package and sent it to only one school in the US.

Shortly after I joined my research group at Kent State, my advisor said, "I'm moving to University of New Mexico, who wants to come?" The following semester our entire research group moved to New Mexico. The decision was easy, but I had to shift the focus of my research from investigating specific materials to more dedicated surface analysis studies. My Ph.D. became all about studying surfaces, and because my Master's degree was in electrochemistry, during my postdoctoral work I decided to combine the two sets of skills and dive into the development of catalysts for fuel cells which heavily rely on both electrochemistry and surface analysis. This is why I joined a group in Chemical Engineering at the University of New Mexico to do my postdoctoral studies. After about three years, I had the option to come to Mines for a research faculty position in the Materials and Metallurgical Engineering Department, and later had an opportunity to join the Chemistry Department.

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X-ray Photoelectron Spectroscopy facility at Mines used frequently by the SAM research group and view inside of the instrument.

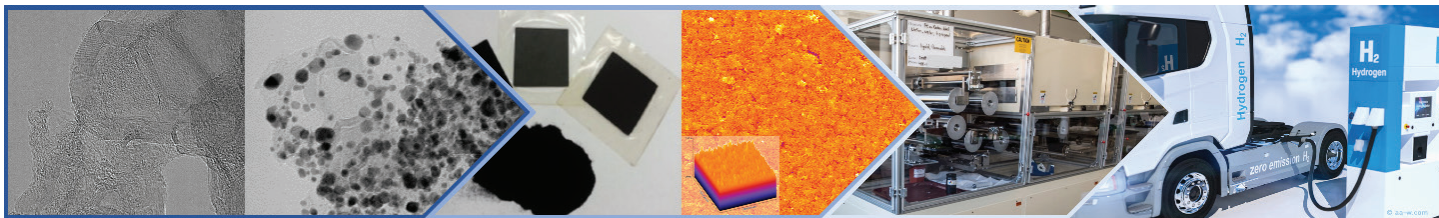
MH Can you give me a brief overview of what you and your research group focus on here at Mines?

SP We focus on studying the surfaces and interfaces of materials for energy applications. Depending on the material or device, there are numerous surfaces, and there are numerous interfaces. Sometimes we try to understand one of them and other times we attempt to understand more than one of them. However, none of the characterization techniques can give you all the necessary information at various scales. From some techniques, you learn elemental composition. From others you get information about morphology. You need a different technique to investigate structure. And yet another method is needed to elucidate chemical composition or spacial distribution. Therefore, you have to use multiple techniques to get full understanding of any functional material. Often, you also want to understand how that material evolved with time in a real operating device. So really, you need to put together a puzzle that is much more complex than a typical 2D puzzle, with many more pieces and other dimensions. Our group is trying to understand the missing pieces that are related to surfaces and interfaces, and we must choose techniques carefully to achieve the right combination to answer the question we have at hand for a specific material or a specific surface and a specific application.

MH With so many different techniques, how do you structure your research team and projects in a way that is effective and allows you and the students to succeed?

SP It takes a while for a student to become an expert in each characterization technique, therefore mentorship is extremely important. I like to have five grad students. That's kind of my sweet number because usually one new student comes in each year and one student leaves, and this gives time for an incoming student to get trained with a more senior student. We also typically have two to four undergrads working with us, and usually, they are paired with more experienced graduate students. But sometimes graduate students become mentors during their first year if we need an extra set of hands on the project because there are a lot of deliverables.

My students spend a lot of time in the lab operating instruments and collecting data. They are trained on how to use the different instruments and can choose to focus on being an expert on one instrument and technique or learn several. For example, one of my current grad students is working primarily with x-ray photoelectron spectroscopy. And there are students who will need to use multiple techniques to answer the questions related to their project. Typically, once data is acquired, students need to process this data, and then we meet to



Graphic by undergraduate students Sara Kim and Max Shepherd. They contributed to a collaborative project with scientists from the University of Connecticut (UConn), the U.S Department of Energy's National Renewable Energy Laboratory (NREL), Fraunhofer Institute for Solar Energy Systems (Fraunhofer ISE), and industry partners Pajarito Powder and Forge Nano.

discuss it. This is my favorite part. If it doesn't look right, we figure out why. We pay attention to small differences, that's where a lot of our new directions come from. I have a good eye for noticing things that students might not notice at first, especially at the beginning but over time they become the drivers of their projects. It takes expertise, experience, and a little bit of art to be good in research.

MH What are some skills you and your students need to succeed in your research?

SP We have a lot of collaborative projects with partners from national labs and industry, with regular bi-weekly or monthly meetings where we have to present updates. I think that's a really good experience for the students because they learn to talk to others about what we do. Some of the collaborators are familiar with the techniques we use, and some are less familiar. So, it's important to relate the information in a different way than you would do within our group. Typically, students from my group do really well in job interviews because they can effectively relate the information they've learned to other people and know how to apply their knowledge to other materials and applications.

MH What do you look for in prospective students who are interested in joining your research team?

SP I look for interest in being a good team member. Mentors can teach students how to use the instruments, how to present their talks, or how to write papers. But the most important skill I strive to develop in my research group is how to be a strong teammate. Sometimes a member has to sacrifice something to help others. Sometimes it's about being proactive to help someone. Sometimes it's about telling someone that they're wrong, or encouraging someone to pursue something they are

hesitant to do. As the group leader, you want each team member to be someone who cares about what they're doing. I don't want someone who thinks of it as a 9-5 job. It doesn't work with science like that. If you get some cool data, you're going to be thinking about it. For me, it is also important that students pass knowledge to others; this was my other motivation for working in academia. I think there is a lot of value to that.



Maddy Hoffmann is a junior in the Engineering Physics program who joined the Reuleaux team in the spring of 2023. She is originally from Redmond, WA, where she grew up in the beauty of the Pacific Northwest. Maddy has been conducting research under the Nuclear Science and Engineering Center (NuSEC) at Mines since her freshman year, and has a passion for scientific research and technical writing. In addition to writing and editing Reuleaux articles, she also enjoys skiing, hiking, climbing, creating digital art, and competing with the Mines Climbing Team. Maddy very much enjoys being part of the Reuleaux editing and publishing team, and hopes that you enjoy the magazine and all of the content it has to offer!