TELLURIDE SCIENCE
& INNOVATION CENTER
ELEVATING SCIENCE AND DISCOVERY

Q & A with Rob Walker

How long have you been involved with Telluride Science?

My first Telluride meeting was in 2008. It was the first Nonlinear Optics at Interfaces organized by Franz Geiger and Alex Benderskii. Except for the 2018 edition, I've attended every one of those workshops since inception, and it remains one of my favorite meetings every time it comes around. In 2016, I also became a workshop organizer. Together with colleagues both at home and abroad, I helped organize two different workshops focused on different scientific challenges relevant to my group's own research activities. One workshop focused on high temperature electrocatalysis to better understand how solid oxide fuel cells (SOFCs) function. A second workshop, Complexity in Chemistry and Physics of Lipid Membranes, brought together scientists from around the world to discuss recent advances and current obstacles that limit our understanding of lipid membrane structure, function and heterogeneity in vitro and in vivo. The high temperature electrocatalysis workshop repeated again in 2019 and was due to meet again last year. COVID, however, postponed that workshop to 2023. The lipid membranes workshop will be meeting this year for the 4th time.

I was invited to join the board by then-past-President Jim Skinner in December, 2019 just before the pandemic. In 2021, I took on the role of TS Treasurer and was elected President this year.

How is Telluride Science different from other scientific conferences and what makes it unique?

Telluride Science workshops are small, 15-25 people, and all attendees are principal investigators or senior scientists who are recognized leaders in their respective fields. The open exchange of ideas, emphasis on unpublished work, identifying new challenges and the vigorous-but-always-professional debates create an environment unlike any other scientific forum. If you ask a scientist who has attended a Telluride Science workshop, they will say, without question, their favorite and most productive experiences happen in Telluride. Telluride workshops are special because they create a forum where colleagues enjoy completely candid, unrestrained exchanges of ideas, critiques and debates about the most pressing issues in science, engineering, and society.

How has the organization impacted your career?

I am a much better and more broadly knowledgeable scientist because of Telluride Science workshops. These workshops naturally incubate far-ranging discussions about important issues that you don't read about in journal articles. More importantly, these conversations with peers are not limited to 20 minutes or an hour, but rather they take place all day, all week, on hikes, on the gondola, over dinner and late into the evening; that full science immersion is like nothing else, and those experiences have certainly had a lasting and profound impact on me. I look forward to Telluride meetings immensely because they remind me that I am, at heart, a scientist, and science is fun!

What is your scientific field of study?

Our group is an optical spectroscopy group that adapts, develops and employs different spectroscopic methods to study chemistry in difficult to access or chemically aggressive environments. In this context, spectroscopy describes how light interacts with molecules and materials. Specifically, we routinely use vibrational Raman spectroscopy, time resolved and steady state emission spectroscopy, thermal imaging, and second order nonlinear optical techniques to study chemical structure, organization, and reactivity. Depending on the application, we'll use an appropriate technique to study chemical processes as diverse as mineral dissolution, bioconcentration, high-temperature electrochemical oxidation, charge transport in new ceramic materials for next-generation Li-ion batteries, or monopropellant combustion at pressures close to 1000 atmospheres. This last project is new, Navy sponsored effort and is intended eventually to learn how torpedo fuel burns. So in truth, our research portfolio is an interdisciplinary polyglot of physical chemistry, chemical physics, and materials science, but the common thread linking all of these projects is using optical spectroscopy to understand better how molecules and materials behave, often under extreme duress.

How is the science you study applied outside of the lab?

Where to start? Ground water salinity from landscape fragmentation – think open-air coal mining, for example – is an increasingly pressing problem in agriculture landscapes, especially in the Intermountain West. The mechanism responsible for dissolution where rock meets water – one of the primary sources of rising groundwater salinity levels – requires understanding chemical stability at that solid/liquid interface. If dissolution can be suppressed or at least controlled, then farmers and ranchers would know when their water is safe for livestock (and human) consumption as well as crop irrigation. The chemical mechanisms responsible for mineral dissolution are best studied using surface specific nonlinear optical spectroscopy. High-temperature energy conversion is another application of our work. SOFCs are high temperature fuel cells that work at temperatures as high as 800 degrees Celsius. We know that the technology will convert fuels such as hydrogen or natural gas into electricity, water, and – if carbon is involved – carbon dioxide. Understanding how that fuel turns into electricity and products is challenging when processes are happening on surfaces that are glowing hot. Using vibrational spectroscopy to observe the chemistry as it happens while measuring the electrochemical performance enables us to correlate reaction mechanisms with device efficiency. When the power starts to fall, we can often identify the chemistry responsible for performance degradation and try to reverse the process. The students working on all of these projects are both creative and tenacious, and thanks to their discoveries, we are learning a lot!

Is there a grand challenge that your field study could potentially solve?

There are so many grand challenges related to health and climate, and they're all important. Public health, climate change, a green economy, environmental resilience . people will prioritize differently and all of them will be correct. For me, the grand challenge most important to me is energy. The transition to hydrogen and renewable fuels will take decades. However, we need to reduce carbon emissions now and we need to do so while using infrastructure that's in transition. We hope that our SOFC research will lead to more durable, efficient devices capable of using conventional fuels today (with twice the efficiency) and hydrogen/green fuels in the future. When you consider that SOFCs can also serve as high temperature electrolyzers, we can begin to think of how technologies enabled by our work can also remove CO_2 from the air. We feel that's a win-win-win outcome.

And last but not least…

Rob is Professor of Chemistry and Biochemistry at Montana State University. He is the founding and former director of Montana Materials Science Program, a cooperative, state wide graduate education program that spans engineering, chemistry, physics and environmental science to provide PHD opportunities for students at universities and colleges in Montana.