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Women Scientists at the Forefront of Energy Research: A Virtual Issue, Part 5

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ENERGY FOCUS

As part of our annual celebration of the contributions of women scientists, we bring you part five of this Virtual Issue series. We highlight the contributions of researchers who have recently published new advances from their laboratories in *ACS Energy Letters*. The successful career paths they have taken to become leaders in the community are likely to impact next-generation energy research. Their short inspirational stories, along with personal reflections, are compiled in this Virtual Issue. We hope that this Virtual Issue can motivate many young researchers to tackle the challenges of energy conversion and storage.

We would like to thank Yi-Chun Lu, Lea Nienhaus, Yi Long, Emma Lovell, Yueh-Lin Loo, Laura Crowe, née Mundt, Lyndsey McMillon-Brown, Raffaella Buonsanti, Yana Vaynzof, Huiqiong Zhou, Yun Jeong Hwang, E. Ashley Gaulding, Xiaodan Zhang, Rui Wen, Milena P. Arciniegas, Katriona Edlmann, Loreta A. Muscarella, Giulia Galli, Aleksandra B. Djurišić, Sarah Wieghold, Jodie Lutkenhaus, Rose Amal, Rosalie Hocking, Nakita Noel, Marta Hatzell, Samira Siahrostami, Derya Baran, Eva Unger, Judith Jeevarajan, and Thuc-Quyen Nguyen for their contributions to this Virtual Issue.

■ NON-PASSIVATING ANION ADSORPTION ENABLES REVERSIBLE MAGNESIUM REDOX IN SIMPLE NON-NUCLEOPHILIC ELECTROLYTES

Yue Sun, Qingli Zou, Wanwan Wang, and Yi-Chun Lu*
ACS Energy Lett. **2021**, *6* (10), 3607−3613 (Letter)
DOI: 10.1021/acsenergylett.1c01780

From left to right: Jiafeng Lei, Yanxin Yao, Fei Ai, Jing Xie, Zhejun Li, Yue Sun, Yi-Chun Lu, Wanwan Wang, Qingli Zou, Dejian Dong, Wei Huang, Zhuojian Liang, and Yang Shi. Photo courtesy of Yang Shi.

I enjoy the process of discovering new things and solving difficult problems—it makes me happy!

The Ph.D. training I got from MIT shapes my research directions. I was very lucky to learn from Prof. Yang Shao-Horn at MIT and Prof. Hubert Gasteiger (Technical University of Munich) that electrochemistry is at the heart of energy research. Their teaching and training for me are the most important foundations of my career in energy research. After joining The Chinese University of Hong Kong, I was very fortunate to work with a group of bright and dedicated young scientists in my research group. They are the energy that inspires me and powers me to go on. I encourage my students to see value in so-called "bad" experimental results. I believe that experimental results are neutral (they are facts, as long as they are correctly obtained), not good or bad. It's up to us to create value from it. I have worked with many female Ph.D. students, and I am very happy to see some of them becoming professors and starting their own research groups to educate the next generation of scientists for energy research, e.g., in this photo, Prof. Zhejun Li, Wuhan University, and Prof. Qingli Zou, Beijing University of Chemical Technology.
Yi-Chun Lu

■ BULK METAL HALIDE PEROVSKITES AS TRIPLET SENSITIZERS: TAKING CHARGE OF UPCONVERSION

Zachary A. VanOrman and Lea Nienhaus*
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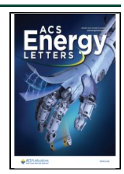
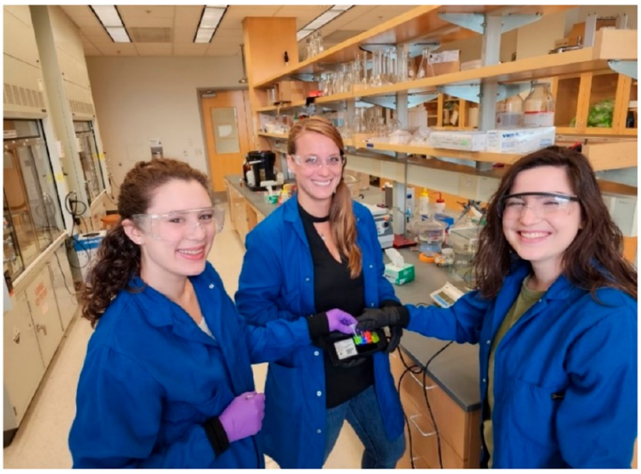




Lea Nienhaus (center) with her graduate students, Rachel Weiss Clark (left) and Colette Sullivan (right), demonstrating the photoluminescence of a wide variety of "glowy things" used in the Nienhaus lab. Photo courtesy of Alexander Bieber.

Chemistry has always been a passion of mine. It all began with a chemistry kit that I received as a child and continued through high school and college. In college, I was particularly drawn to surface science and the—for me—invisible world of nanoscience, which ultimately resulted in a Ph.D. focused on optical scanning tunneling microscopy. The idea of visualizing and manipulating atoms was (and is) mind-blowing! How could a single atom change the properties of the material around it?

My present interest and involvement in energy science were sparked when I was confronted with the world of nanocrystals and bulk perovskite semiconductors and their applications upon starting my postdoctoral work. Fortunately, both my Ph.D. advisor Martin Gruebele and my postdoc advisor Moungi Bawendi allowed me to freely choose my research direction, which ended up being energy-related science. Inspiring discussions during countless coffee breaks with members of the Buonassisi group reinforced my choice and have ultimately led to fruitful collaborations that have continued into my (and also their) independent careers.

I will never become tired of looking at photoluminescent samples and seeing the joy their glow instills in my students. My students are the bright spotlight guiding our research, their curiosity and perseverance when faced with a tough challenge, are inspiring, and I couldn't follow this path without their unwavering support.

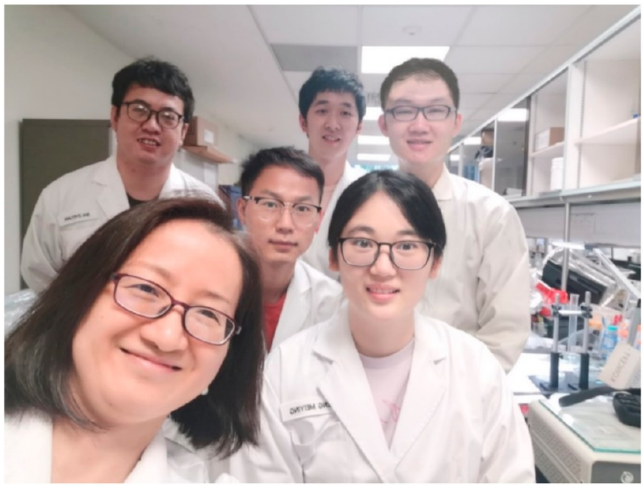
My advice to anyone just getting started: Ask as many questions as you can, find a good team of collaborators, and have fun in your research. Hold onto that joy in tough times. Don't be afraid to try something new, even if it seems crazy—it may be the key to unlocking the scientific mystery in front of you.

Lea Nienhaus

■ ON-DEMAND SOLAR AND THERMAL RADIATION MANAGEMENT BASED ON SWITCHABLE INTERWOVEN SURFACES

Yujie Ke, Yanbin Li, Lichen Wu, Shancheng Wang, Ronggui Yang, Jie Yin*, Gang Tan*, and Yi Long*

ACS Energy Lett. **2022**, 7 (5), 1758−1763 (Letter)
DOI: 10.1021/acsenergylett.2c00419



The YI's group at NTU (previous)/CUHK (now) studies smart materials and devices for energy-saving applications. Left to right, top row: Zhiyuan Bai, Huaxu Liang, Dr. Zhenggui Zhou, Dr. Shancheng Wang. Bottom row: Prof. Yi Long and Dr. Meiying Leng. Photo courtesy of Yi Long.

I have a unique and winding career path. After graduating from Cambridge University with training in the characterization of superlattice structured ceramics made in the ultra-high-vacuum system, I devoted six years to technologies transfer to industry as a principal investigator without postdoc training. In 2012, I switched to academic research to design smart windows with a humble beginning (one funded part-time Ph.D. student). My commitment to develop energy-saving windows was profoundly solidified as the grand challenge, coming from the fact that windows consume 4% of primary energy usage in some developed countries. There are an infinite number of aspects to be considered to develop a usable smart window and endless tantalizing scientific questions to be answered in smart materials, specifically about my favorite vanadium dioxide and hydrogel. My appreciation for this one decade of developing energy-saving smart device science has deepened and broadened, and I am delighted to apply my earlier rigorous training on far more controlled superlattice systems to the more complicated interdisciplinary applied research. My advice to young students who read this narrative:

- *Be critical.* As Feynman put it, science is a culture of doubt. Read literature and doubt it.
- *Ask for help.* Research is interdisciplinary, and it takes a village to raise good research. I didn't travel much when my kids were young. Fortunately, most of my collaborations are just one email away and I have never met two-thirds of them in 3D. The mutual trust and respect in the research community are the classic beauty of our jobs.
- *Be your own master.* Value what you give your energy and time to. You reap what you sow.

Yi Long

■ TWO STEPS BACK, ONE LEAP FORWARD: SYNERGISTIC ENERGY CONVERSION IN PLASMONIC AND PLASMA CATALYSIS

Emma C. Lovell*, Jason Scott*, Nicholas M. Bedford, Tze Hao Tan, Patrick J. Cullen, Kostya Ken Ostrikov, and Rose Amal

ACS Energy Lett. **2022**, 7 (1), 300−309 (Perspective)
DOI: 10.1021/acsenergylett.1c02387

From left to right: Ahmad Zhafran Bin Md Azmi, Keivan Rahimi, Emma Lovell, Maggie Lim, Yi Fen (Charlotte) Zhu, and Son Bui. Photo courtesy of Victor Wong.

It is said that passions are developed, not always discovered. Throughout my academic career, I have been fortunate to have exposure to many different experiences, which has deepened my passion for research in catalysis for energy applications. It has been these varied experiences that galvanized my future goals and culminated in the understanding that through research, we have the ability to impact profound change to combat the world's most significant challenges. One of my mentors once put energy research to me like this: "Whilst you may not make one big discovery that will change the world, you are contributing to a pool of knowledge that certainly will." I feel immense privilege that I am part of this research community, contributing to a more green, sustainable, and equitable future.

My research journey has taken me from thermal catalysis for the mitigation of anthropogenic carbon dioxide all the way through to plasma, plasmonics, and electrochemistry. There is a great thrill and privilege in translating materials to a range of applications. In this, I have learned that it is diversity (in all forms) that truly drives innovation.

I share this advice with emerging young researchers considering a career in energy research: There is power in saying yes to new opportunities that come your way and also proactively seeking out new experiences that broaden your horizons. You may not be successful in everything you try, but you will surely learn a lot about yourself in the process.

Emma Lovell

■ DESIGN OF UV-ABSORBING DONOR MOLECULES FOR NEARLY IMPERCEPTIBLE ORGANIC SOLAR CELLS

Melissa L. Ball, Quinn Burlingame, Hannah L. Smith, Tianran Liu, Sean R. Parkin, Antoine Kahn, and Yueh-Lin Loo*

ACS Energy Lett. **2022**, 7 (1), 180−188 (Letter)

DOI: 10.1021/acsenergylett.1c02244

Group photo taken August 2021. From left to right: Melissa Ball, Adam Berry, Lynn Loo, Yannick Eatmon, Quinn Burlingame, Tianran Liu, Trey Holley, Alan Kaplan, Marko Ivancevic, and Xiaoming Zhao. Photo courtesy of Frank Wojciechowski.

I write from the sunny city state of Singapore, where I am 15,000 km away from my research team in Princeton, NJ. We conduct regular research meetings via Zoom; this has been the default mode of operation for the past two and a half years. How is research going—with this unusual arrangement, especially post-COVID—you might ask? Our research program has never been stronger, and we've never been more focused and productive—the team continues to plow away at addressing the fundamental challenges in developing transparent photovoltaics and perovskite solar cells. In the past year, we reported the most visibly transmissive and color-neutral transparent photovoltaics that can be integrated with windows, and the most stable perovskite solar cells with extrapolated lifetimes exceeding 30 years under normal operation.

During the day, I lead the Global Centre for Maritime Decarbonisation (GCMD), a non-profit founded in 2021 to help international shipping accelerate its decarbonization efforts through shaping standards for future fuels, financing first-of-a-kind projects, and piloting low-carbon solutions under real-world operating conditions. In the past year, we have commissioned a study to define the safety and operations envelopes for bunkering ammonia as a future marine fuel, launched a pilot involving 13 container liners, bulkers, and tankers bunkering sustainable biofuels at three ports on three continents to bolster the integrity of the green fuels supply chain, and initiated a pilot to demonstrate end-to -end shipboard carbon capture at scale.

The time and length scales between the challenges I think about in the evenings and during the day cannot be more disparate! Yet simultaneously thinking about the fundamentals that enable nascent photovoltaic technology development and the challenges and opportunities of maritime decarbonization has made me a stronger teacher and mentor and a better leader. My continued involvement in basic research has brought academic rigor and discipline to GCMD's due diligence and project scoping and curation processes; my exposure to the commercial aspects of low-carbon solutions adoption has, in turn, lent a more pragmatic and practical lens to the choice of problems we tackle in the labs. Never have I felt more empowered to make meaningful contributions to the energy transition through my engagements in both worlds!

With this, I strongly advocate that we step outside our comfort zones on occasion—the experience be can exhilaratingly rewarding.

Yueh-Lin Loo

https://doi.org/10.1021/acsenergylett.2c02727
ACS Energy Lett. 2023, 8, 853−868

■ MIXING MATTERS: NANOSCALE HETEROGENEITY AND STABILITY IN METAL HALIDE PEROVSKITE SOLAR CELLS

Laura E. Mundt*, Fei Zhang, Axel F. Palmstrom, Junwei Xu, Robert Tirawat, Leah L. Kelly, Kevin H. Stone, Kai Zhu, Joseph J. Berry, Michael F. Toney*, and Laura T. Schelhas*

ACS Energy Lett. **2022**, 7 (1), 471−480 (Letter)
DOI: 10.1021/acsenergylett.1c02338

Laura Crowe (née Mundt). Photo courtesy of Pat Millham.

The first and maybe most formative step toward my career in energy research was starting as a research assistant at Fraunhofer Institute for Solar Energy Systems. Working at the largest solar research institute in Europe opened my eyes to the importance of renewable energy and the idea that I could directly contribute to this research and make a difference in the world with my own work and ideas. Years later, at the end of my postdoc, several people suggested I should switch my research focus away from photovoltaics (for different reasons and with the best of intentions). I realized that this wasn't an option because my research is not just a job, it is a fundamental part of what drives me and what I care about—enabling access to affordable and sustainable energy is key to building up social equity.

What I have always loved most about my work is that it allows me to get to know and work with so many different, passionate, and wonderfully smart people all over the world who all have one shared desire: to make this world a better place for the generations to come after us. My advice for young researchers is to figure out what motivates them and do what they are most passionate about. Don't underestimate your own potential—we all have started small!

Laura Crowe née Mundt

■ WHAT WOULD IT TAKE TO MANUFACTURE PEROVSKITE SOLAR CELLS IN SPACE?

Lyndsey McMillon-Brown*, Joseph M. Luther, and Timothy J. Peshek

ACS Energy Lett. **2022**, 7 (3), 1040−1042 (Energy Focus)
DOI: 10.1021/acsenergylett.2c00276

Lyndsey McMillon-Brown and her postdocs. From left to right: Drs. Kaitlyn VanSant, Lyndsey McMillon-Brown, and Kyle Crowley. Photo courtesy of Lyndsey McMillon-Brown.

I had a strong desire to pick a career where I could improve the human condition and preserve the environment. Once a child fascinated by NASA, as an adult, I was quickly enticed by the opportunity to aid in developing technology for NASA while simultaneously addressing climate challenges. My work focuses on the development of novel materials for energy harvesting applications. This subject area is at the interface of materials science, engineering, chemistry, and art—all personal interests of mine. I find my research to be tremendously rewarding. One of the most rewarding research experiences I have had in my career has been preparing and flying research samples on the International Space Station. This was the first long-term space flight of perovskite solar cells and an achievement for my research group to design and prepare experiments that successfully demonstrated the durability of these devices in space. I feel fortunate to have the opportunity to work at the frontier of research and share our findings with the world as we develop technology to enable a sustained human presence on the Moon and, eventually, Mars.

I would advise newcomers in the field to put people first as they pursue research. Relationships are invaluable and it is important that we nurture, respect, and value all people as we strive to improve the human condition through science. I am equally proud of the impact I have had on my mentees as I am of my science results. There is room for all of us. Our discoveries will only be made better and more impactful by increased diversity and inclusivity of all.

Lyndsey McMillon-Brown

■ WELL-DEFINED COPPER-BASED NANOCATALYSTS FOR SELECTIVE ELECTROCHEMICAL REDUCTION OF CO_2 TO C_2 PRODUCTS

Ludovic Zaza, Kevin Rossi, and Raffaella Buonsanti*
ACS Energy Lett. **2022**, 7 (4), 1284−1291 (Perspective)
DOI: 10.1021/acsenergylett.2c00035

Raffaella Buonsanti (middle) with co-workers Anna Loiudice (left) and Laure Dayer (right) during one of the group retreats in the Swiss Alps. Photo courtesy of Raffaella Buonsanti.

My path to being a professor and to the current research topics in my group was neither deliberate nor strategically planned but developed through the opportunities I encountered.

During my Ph.D. studies in Italy, I worked on the colloidal synthesis of titanium dioxide nanocrystals for dye-sensitized solar cells. My dream to continue my scientific journey in Berkeley became true when I was hired as a postdoctoral researcher at Lawrence Berkeley National Laboratory. There, I got a chance to work on the synthesis of doped oxide nanocrystals for smart windows. Three years later, the Joint Center for Artificial Photosynthesis opened a tenure-track staff scientist position. I applied and got the position! I learned a lot about photo- and electrocatalysis, which was a new field for me. After a couple of years, a colleague encouraged me to apply for an opening at École Polytechnique Fédérale de Lausanne. Moving back to Europe was not my priority, but I decided to explore this opportunity. The support which was offered for my research was unbeatable. So, my new adventure as a tenure-track Assistant Professor began. I started applying my knowledge in the synthesis of well-defined nanocrystals to electrocatalysis as I believed I could help address many uncovered fundamental questions in this important field of research for the societal energy transition. Recently, I was promoted to tenured Associate Professor. I am grateful to all the people I have had the pleasure of working with over the past years. There are difficult days, no doubt, yet I enjoy my academic life very much!

My advice to young researchers: Enjoy every day of your scientific journey, work hard, be competitive with yourself, be curious and open-minded, and always try to learn something, even from what you might initially see as “failures”—the rest will come!

Raffaella Buonsanti

■ THE CHALLENGE OF MAKING THE SAME DEVICE TWICE IN PEROVSKITE PHOTOVOLTAICS

Katelyn P. Goetz and Yana Vaynzof*
ACS Energy Lett. **2022**, 7 (5), 1750−1757 (Viewpoint)
DOI: 10.1021/acsenergylett.2c00463

The Vaynzof Group in Fall 2022. Left to right: Andrés Guerrero León, Yanxiu Li, Tim Schramm, Ran Ji, Zongbao Zhang, Angelika Wrzesińska, Marielle Deconinck, Yvonne Hofstetter, Yana Vaynzof, Elena Siliavka, Ruth Pinheiro Muniz, Oscar Telschow, Raquel Campos, Lucas Scalon, Julius Brunner, Elizabeth Baird, and Migual Albaladejo-Siguan. Photo courtesy Fabian Paulus.

Having studied electrical engineering for my bachelor’s and master’s degrees and physics for my Ph.D., I learned that the key difference between these disciplines is in the question being asked: engineers ask “How?” while physicists ask “Why?” One of the reasons I truly enjoy research in the field of emerging photovoltaics is that it allows me to combine these questions and ask “*Why* does the solar cell work the way it does, and *how* can we make it better?”

Another aspect I find highly stimulating is the staggering pace of innovation and progress in this field, which means that every day I get to learn something new. Finally, the most rewarding part of my research is working with a talented group of young researchers who are as passionate about emerging photovoltaics as I am.

To the young researchers in this field, I would advise not to lose their enthusiasm when experiments fail and things don’t work out as planned. Some of the best discoveries were made accidentally, so don’t be afraid to try something entirely new (and a little bit crazy) and allow yourselves to be amazed by the outcome, even if it is not what you expected!

Yana Vaynzof

■ PSEUDOHALIDE-ASSISTED GROWTH OF ORIENTED LARGE GRAINS FOR HIGH-PERFORMANCE AND STABLE 2D PEROVSKITE SOLAR CELLS

Weichuan Zhang, Xianxin Wu, Jin Zhou, Bing Han, Xinfeng Liu*, Yuan Zhang*, and Huiqiong Zhou*
ACS Energy Lett. **2022**, 7 (5), 1842−1849 (Letter)
DOI: 10.1021/acsenergylett.2c00485

Professor Huiqiong Zhou. Photo courtesy of Huiqiong Zhou.

During my Ph.D. studies, I was fascinated by the beauty of nanomaterials observed under SEM, which motivated me to pursue scientific research. Later, I joined Professor Alan J. Heeger's group in the Physics Department at UC Santa Barbara as a postdoc researcher. Then I stepped into the energy field and started to work on solution-processed organic solar cells. At that time, Prof. Heeger was in his 70s and still active at the scientific forefront. I was deeply impressed by his pure love of science. With a chemistry background, I learned a lot of new techniques in semiconductor physics and device physics. The experiences at UCSB encouraged me to think independently, keep an open mind to new things, and be bold to face and overcome obstacles.

Since I started my independent career at the National Center for Nanoscience and Technology (China), I have focused on solution-processed photovoltaics (including organic and perovskite solar cells), especially on various interfacial problems existing in the devices, seeking new interfacial materials and modification strategies, and understanding the impact of interfaces on devices' working process and device performance. More recently, my group has been devoting our efforts to improving the device stabilities for these emerging photovoltaics. Here, I would like to share my advice to younger researchers: Never set limitations for yourself, try your best, and see where you can arrive.

Huiqiong Zhou

ORIGIN OF HYDROGEN INCORPORATED INTO ETHYLENE DURING ELECTROCHEMICAL CO_2 REDUCTION IN MEMBRANE ELECTRODE ASSEMBLY

Woong Choi, Seongho Park, Wonsang Jung, Da Hye Won, Jonggeol Na*, and Yun Jeong Hwang*

ACS Energy Lett. **2022**, 7 (3), 939−945 (Letter)
DOI: 10.1021/acsenergylett.1c02658

Left to right, front: Eunchong Lee, Si Young Lee, Yun Jeong Hwang, Dongwoo Shin, and Seongin Hong. Back: Hyunsung Jang, Jimin Kim, Yewon Hong, Hyewon Yun, Suhwan Yoo, Yeongbae Jeon, and Gwangsu Bak. Photo courtesy of Yun Jeong Hwang.

Since I received my Ph.D. as a chemist and started independent research at a national research institute, I have had a dream that my research could contribute to solving social problems, even if it takes time to apply. Combined with an increasing interest in nanomaterials, I focused on developing an electrochemical CO_2 reduction reaction system as an approach to artificial photosynthesis. It was an attractive concept in future environmental and energy technology, but I soon realized that industrial applications cannot be realized without collaborative ideas from different research scopes, i.e., fundamental, improvement, process, or evaluation. I was fortunate to work together and get research feedback from a multidisciplinary research team to find the important questions, and also experienced that I could make a contribution from a chemist's point of view. Our report in *ACS Energy Letters* is one example and was designed from an "aha!" moment of chemical identification to understand the chemical reaction within a full-cell electrolyzer. I remember that my first electrochemical CO_2 reduction experiments only produced mostly hydrogen and taught the importance of the chemical activity on the catalyst surface. Later, a full-cell CO_2 electrolyzer system with a gas-diffusion electrode broke the previous prejudice in the performance. However, I wanted to make links between them based on chemistry and looked into the full-cell electrolyzer to see how the molecules and atoms are involved in the reaction.

For the newcomers in this multidisciplinary field, I encourage them to have unbiased and respectful perspectives between fundamental and progressive research, and enjoy collaboration between diverse disciplines. In addition, we also have to keep in mind to investigate questions with our own research identity.

Yun Jeong Hwang

PACKAGE DEVELOPMENT FOR RELIABILITY TESTING OF PEROVSKITES

E. Ashley Gaulding*, Amy E. Louks, Mengjin Yang, Robert Tirawat, Mickey J. Wilson, Liam K. Shaw, Timothy J Silverman, Joseph M. Luther, Axel F. Palmstrom, Joseph J. Berry, and Matthew O. Reese*

ACS Energy Lett. **2022**, 7 (8), 2641−2645 (Energy Focus)
DOI: 10.1021/acsenergylett.2c01168

Ashley Gaulding. Photo taken by Bryan Bechtold for NREL's public image gallery.

Curiosity and a desire to leave the world a better place are what led me to energy research. It was not a clear path, but one laid out in pieces by listening to encouraging mentors and taking chances on unexpected opportunities. Though neither are scientists, my parents nurtured my scientific curiosity (the scientists on *Nova* were my childhood heroes!). However, when graduating high school, I didn't know enough about scientific career paths to pursue one. Then after working two years at a small guitar pedal company, I read a special issue in *Scientific American* titled "Energy's Future Beyond Carbon". I became convinced that clean energy was important.

I took science classes in the evenings at the Minneapolis Community and Technical College. There I had a teacher, Kirk Boraas, who showed me how fun chemistry could be. I transferred to the University of Minnesota, where the first class I took was Intro to Materials Science Engineering. The class professor, Eray Aydil, invited me to work in his lab. The idea that undergrads were even allowed to work in an academic lab shocked me, and I gladly took him up on his offer. Later he encouraged me to apply to a summer internship program. I stumbled upon the SULI (Science Undergraduate Laboratory Internship) program and discovered the "National Renewable Energy Lab". This seemed like the natural place to be, and after two summer internships at NREL and completing my Ph.D., I was fortunate enough to become a staff scientist there! This has allowed me to contribute across fields, from photoelectrochemistry to emerging PV. My career advice is to always pursue what excites you, even when the path is muddy, and embrace unexpected opportunities.

E. Ashley Gaulding

■ A TWO-STEP SOLUTION-PROCESSED WIDE-BANDGAP PEROVSKITE FOR MONOLITHIC SILICON-BASED TANDEM SOLAR CELLS WITH >27% EFFICIENCY

Bingbing Chen, Pengyang Wang, Renjie Li, Ningyu Ren, Wei Han, Zhao Zhu, Jin Wang, Sanlong Wang, Biao Shi, Jingjing Liu, Pengfei Liu, Qian Huang, Shengzhi Xu, Ying Zhao, and Xiaodan Zhang*

ACS Energy Lett. **2022**, 7 (8), 2771−2780 (Letter)
DOI: 10.1021/acsenergylett.2c01488

Xiaodan Zhang. Photo courtesy of Xiaodan Zhang.

Before I started scientific research, I was a physics teacher in a high school for four years. However, I was lucky to participate in the research of silicon thin-film tandem solar cells in the "973" national key basic research project of the Ministry of Science and Technology during my doctoral research period. The four-junction silicon thin-film tandem solar cell we fabricated made it an unforgettable experience for me. Its power conversion efficiency reached 14.58%, setting a world record at that time. Later, I realized that developing low-cost and high-efficiency solar cells was a very meaningful work, which encouraged me to continue to engage in scientific research. In 2012, perovskite solar cells gradually came into the view of researchers, with the potential of low cost and high efficiency, and quickly became superstars in the photovoltaic research field. Since then, I have devoted my research work to providing stable, low-cost, and high-performance perovskite/crystalline silicon tandem solar cells to promote the development of industrial applications.

There were many exciting moments in the past 20 years of my scientific research career, such as breakthroughs in solar cell efficiency, and students have been rewarded. Here are some tips I can share with young researchers: Interest is your best teacher, and scientific research requires strong curiosity and continuous learning. In addition, please remember that everyone has inertia. We are ordinary people. If you want to become better, you must go beyond your comfort zone.

Xiaodan Zhang

■ IN SITU VISUALIZATION OF ELECTROCHEMICAL PROCESSES IN SOLID-STATE LITHIUM BATTERIES

Jing Wan, Hui-Juan Yan, Rui Wen*, and Li-Jun Wan

ACS Energy Lett. **2022**, 7 (9), 2988−3002 (Focus Review)
DOI: 10.1021/acsenergylett.2c01069

Rui Wen. Photo courtesy of Rui Wen.

My research field has been focused on interfacial electrochemistry. During my Ph.D. studies at Institute of Chemistry, Chinese Academy of Sciences (ICCAS), I utilized *in situ* scanning tunneling microscopy (STM) to probe the electrochemical processes at the electrode/electrolyte interfaces. I was always inspired when I successfully observed the structure and dynamics of the adsorbed molecule during electrochemical reaction.

When I was a postdoctoral researcher at Tohoku University, I started to get interested in the electrochemical interfaces in energy storage batteries. It would be remarkably significant if the complex electrode process in a working battery could be directly captured during charging and discharging. Fortunately, I was later hired as a postdoctoral researcher at RIKEN. There, I was engaged in an in situ atomic force microscopy study of cathode/electrolyte interfaces in Li-O_2 batteries.

In 2015, I joined ICCAS and established my independent research group. Ultimately, it is greatly inspiring that we have achieved *in situ* detection and measurement of the evolution processes at liquid-solid, gas-liquid-solid and solid-solid interfaces in lithium batteries using electrochemical scanning probe microscopy (SPM). Furthermore, those *in situ*/operando findings contribute to the in-depth understanding of the complex interfacial structure and dynamics at microscale for the rational optimization and design of electrochemical devices.

Here is my advice to young researchers: 1. Face the failure instead of being afraid of it. 2. Chose the challenging work instead of comfortable one. 3. Stick to one thing and do the best.

Rui Wen

■ DESIGNING RUDDLESDEN−POPPER LAYERED PEROVSKITES THROUGH THEIR ORGANIC CATIONS

Milena P. Arciniegas* and Liberato Manna*

ACS Energy Lett. **2022**, 7 (9), 2944−2953 (Perspective)
DOI: 10.1021/acsenergylett.2c01415

Milena P. Arciniegas, Researcher/Team Leader, Center for Convergent Technologies, Istituto Italiano di Tecnologia. Photo courtesy of Milena P. Arciniegas.

My research activities started in Barranquilla (Colombia), where I worked on metal alloys. I was always fascinated by the extreme versatility of materials and how creating new ones could help solve different problems. This is reflected in my career, which is focused on the design of new materials at different scales and in different application fields. It also motivated me to move overseas to Ghent (Belgium) and later to Barcelona (Spain), where I pursued my doctoral studies. Following my Ph.D., I changed my research fields twice: in 2009 I moved toward composite materials for aviation (Sheffield, England), and in 2012 I started to perform research on nanomaterials (Genova, Italy). These changes were challenging, but I took them as opportunities to learn continuously.

When I joined the Nanochemistry Department at IIT, I was introduced to the field of materials for energy. I was fascinated by the possibility of engineering materials at the nanoscale and designing them for distinct functionalities. Here, I brought in my engineering approach! It has been 10 years since then, and my current research focuses on the development of hybrid layered structures. To me, their design and synthesis are like a LEGO pool. We investigate new combinations to develop white emitters and provide more efficient illumination sources. Among the “aha!” moments in this journey, I remember one right before the pandemic when I realized how helpful machine learning and digital tools for data analysis could be for my team. Since then, I got passionate about automated fabrication processes and data collection and management, and I motivate my students to integrate them into our daily activities. My advice to the newcomers in the field: Listen carefully and be wild. Science needs open minds, creativity, and people from all backgrounds. It is normal to feel insecure sometimes but embrace those moments. And make sure you find satisfaction in your private life, aside from your research.

Milena P. Arciniegas

■ GEOLOGICAL HYDROGEN STORAGE: GEOCHEMICAL REACTIVITY OF HYDROGEN WITH SANDSTONE RESERVOIRS

Aliakbar Hassanpouryouzband*, Kate Adie, Trystan Cowen, Eike M. Thaysen, Niklas Heinemann, Ian B. Butler, Mark Wilkinson, and Katriona Edlmann*

ACS Energy Lett. **2022**, 7 (7), 2203−2210 (Letter)
DOI: 10.1021/acsenergylett.2c01024

Left to right: Alexis Cartwright Taylor, Lubica Slabon, Elise Morat, Katriona Edlmann, Bethan Payne, and Hannah Bryant. Photo courtesy of Katriona Edlmann.

I have always been fascinated by the glimpse into the past that is revealed through geology, which now provides evidence for anthropogenic climate change. Geology can also deliver solutions to mitigate climate change, and my research is inspired by how we can use the subsurface to decarbonize energy. This ranges from reducing emissions by locking captured CO_2 in deep geological formations through to preventing emissions using sustainable low-carbon energy technologies such as geothermal energy and hydrogen storage.

I began my petroleum industry laboratory-based Ph.D. in the early 1990s at a pivotal moment when the impact of anthropogenic climate change was being recognized across the scientific community. During a 10-year maternity break immediately after my Ph.D., carbon capture and storage research gained momentum, centered around computer modeling, with little experimental data to ground truth the models. As such, my laboratory skills were in demand, and I restarted my academic career. Since then, I have been lucky to work alongside many talented researchers, all dedicated to delivering sustainable and equitable low-carbon energy.

There is a growing optimism among hydrogen energy researchers, industry, and policymakers, working with an inclusivity that is extremely motivating. I encourage all early career researchers in energy to speak up, share your research, and network as widely as you can. People are listening and recognize that we cannot carry on with business as usual in energy.

Katriona Edlmann

■ HALIDE DOUBLE-PEROVSKITE SEMICONDUCTORS BEYOND PHOTOVOLTAICS

Loreta A. Muscarella* and Eline M. Hutter*

ACS Energy Lett. **2022**, 7 (6), 2128−2135 (Perspective)
DOI: 10.1021/acsenergylett.2c00811

Photo of Loreta A. Muscarella. Photo courtesy of Valerio Favale.

My first approach to perovskites was in 2016, when I was looking for an internship abroad. The unique compositional tunability of perovskites, which allows for compositions with diverse bandgap and optoelectronic properties, was so exciting and left no doubt about my next research direction. Over time, I realized that these materials are not only interesting for fundamental studies, but they also can be very promising for many applications (e.g., lighting, display, solar cells), and it is no coincidence that there are so many scientific publications out there. But with perovskites it is not all rainbows and unicorns!

One of the toughest moments in the lab was when we were trying to investigate phase segregation in mixed-halide perovskites as a function of applied external pressure. We had three lasers of different sizes to be overlapped and focused inside a closed pressure cell. Aligning lasers is challenging, but even more so when you cannot see where your lasers are! From this, I learned that science can be frustrating and requires patience and persistence, but this will be eventually rewarded.

My advice to young researchers is this: Take care of yourself, cultivate hobbies and nourish social relationships, listen to your body, and take a break when needed. Creative ideas come when our brain is rested and has time to think! Expose yourself to different environments and talk about your science with people with different backgrounds. Interdisciplinary cooperation is key to solving complex problems! Finally, never forget to surround yourself with the right people who can truly support you when needed.

Loreta A. Muscarella

■ UNDERSTANDING THE EFFECT OF LEAD IODIDE EXCESS ON THE PERFORMANCE OF METHYLAMMONIUM LEAD IODIDE PEROVSKITE SOLAR CELLS

Zeeshan Ahmad, Rebecca A. Scheidt, Matthew P. Hautzinger, Kai Zhu, Matthew C. Beard, and Giulia Galli*

ACS Energy Lett. **2022**, 7 (6), 1912−1919 (Letter)
DOI: 10.1021/acsenergylett.2c00850

Photo of Guilia Galli, University of Chicago. Photo courtesy of Guilia Galli.

Twenty years ago, I began working on computational investigations of colloidal nanoparticles for solar cells. Admittedly, I was not well versed in energy research at the time, and my interest in nanoparticles was mostly motivated by the search for model systems to test the validity of *ab initio* electronic structure calculations for quantum confined semiconductors. However, upon further exploration of colloidal quantum dots as possible solar energy absorbers, I recognized the importance and excitement of problems related to materials for energy applications. But it was only in 2008, when I joined the Center for Chemical Innovation (CCI) led by Harry Gray, that I was finally struck by the need and urgency of designing robust theoretical and computational strategies to predict materials and systems to harness solar energy.

The CCI was a great source of inspiration and education on solar energy, and importantly, the center's projects led me to change the way I approached problems on materials for energy. I set up collaborations with several experimentalists and started learning how to tightly integrate theory, computation, and experiments to design optimal materials for photoelectrochemical cells. Such integration is a difficult task of paramount importance. Gratifyingly, several of the CCI collaborations are still ongoing, for example, the one with Kyoung-Shin Choi on photo-absorbers. Further, a close collaboration with the experimental group of Matt Beard led to our best progress toward designing quantum dots and perovskites for solar cell applications.

My advice to newcomers would be to constantly seek innovative ways to combine the most diverse expertise when attacking energy problems.

Giulia Galli

Annie Ng, Jasminka Popovic, and Aleksandra B. Djurišić. Photo courtesy of Aleksandra B. Djurišić.

I graduated from an Engineering Physics program, which formed my attitude toward research—a strong sense of scientific curiosity and a need to understand how things work, but tempered with grounding in practically relevant pursuits. Throughout my career, I have worked on a wide range of materials, including organic semiconductors, various oxide and nitride nanomaterials, and finally, organic−inorganic metal halide perovskite materials. The unifying theme for all these materials has always been applications in energy and the environment, whether it is energy generation, energy storage, or pollutant degradation. My primary research interest in recent years has been organic−inorganic lead halide perovskite materials and devices. They are not only fascinating from the fundamental science point of view, but they have also demonstrated a rapid advance in efficiency for both solar cells and light-emitting devices. Despite rapid progress in this research field, there are still unanswered questions concerning fundamental properties of these materials, and there is a need to improve their stability as well as address the issue of environmental impact if perovskite technology would become widely adopted.

My advice to young researchers in the field would be to always keep in mind fundamental principles, to develop a reliable collaboration network with complementary expertise (you do not need to be and, in fact, you likely cannot be an expert in everything), and to enjoy the excitement of discovery and contributing to the scientific progress in this important research area.

Aleksandra B. Djurišić

■ PHOTOINDUCED SEGREGATION BEHAVIOR IN 2D MIXED HALIDE PEROVSKITE: EFFECTS OF LIGHT AND HEAT

Tik Lun Leung, Zhilin Ren, Ali Asgher Syed, Luca Grisanti, Aleksandra B. Djurišić*, and Jasminka Popović*

ACS Energy Lett. **2022**, 7 (10), 3500−3508 (Letter)
DOI: 10.1021/acsenergylett.2c01688

■ STRESSING HALIDE PEROVSKITES WITH LIGHT AND ELECTRIC FIELDS

Sarah Wieghold*, Emily M. Cope, Gregory Moller, Nozomi Shirato, Burak Guzelturk, Volker Rose, and Lea Nienhaus*

ACS Energy Lett. **2022**, 7 (7), 2211−2218 (Letter)
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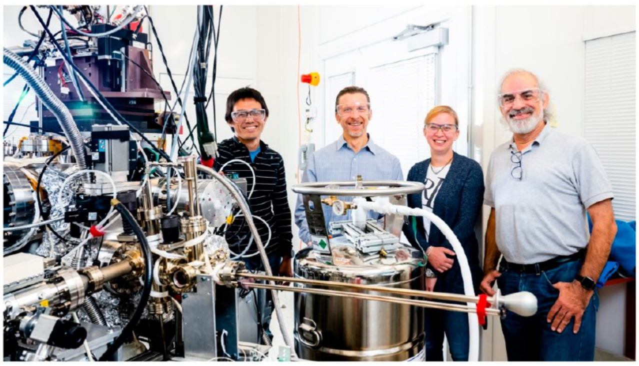

Left to right: Nozomi Shirato, Volker Rose, Sarah Wieghold, and Daniel Rosenmann. Photo courtesy of Nicholas Lundvick.

I realized that I wanted to work at the challenging intersection of materials synthesis and multi-scale structural and electrical characterization of energy materials during my Ph.D. studies. One of my first Ph.D. projects was based on creating molecular networks where the absorption range can be tailored for use in energy conversion applications. This project really caught my attention, and I saw the huge potential of these energy materials. At the same time, I had so many questions: What else can be done, and how can we achieve it?

In the following years, I pursued my research interests and explored silicon and halide perovskite materials that can be used in the solar application during my postdoctoral studies at the Massachusetts Institute of Technology and Florida State University. During those research stays, I also had the great opportunity to visit the Advanced Photon Source (APS), a U.S. Department of Energy (DOE) Office of Science user facility at DOE's Argonne National Laboratory, and see a synchrotron—and all the beamlines and respective techniques around the ring—for the first time. I was fascinated by the techniques that allow you to study energy materials in such great detail, even down to the atomic scale, in high resolution. Today, I work as a beamline scientist at the APS, a place that brings together scientists from all around the world with different backgrounds to tackle energy-related challenges.

I encourage young researchers to never stop being curious and pursue the research direction they like. Research can often be challenging, but it is of great value to see the contribution our work in the field of energy materials can make in the fight against climate change.

Sarah Wieghold

■ ANION IDENTITY AND TIME SCALE AFFECT THE CATION INSERTION ENERGY STORAGE MECHANISM IN $Ti_3C_2T_x$ MXene MULTILAYERS

Junyeong Yun, Varun Natu, Ian Echols, Ratul Mitra Thakur, Huaixuan Cao, Zeyi Tan, Miladin Radovic, Micah J. Green, Michel W. Barsoum, and Jodie L. Lutkenhaus*

ACS Energy Lett. **2022**, 7 (5), 1828−1834 (Letter)

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Members of the Lutkenhaus lab. Appearing in the photograph: Alexa Easley, Emi Braide, Ian Echols, Khirabdhi Mohanty, Natalie Neal, Suvesh Lalwani, Suyash Oka, Ting Ma, Yinan Yang, Grant Shamblin, and Jodie Lutkenhaus. Photo courtesy of Jodie Lutkenhaus.

Early in my career, I became fascinated with "all things molecular". I was curious about how redox reactions could be controlled by the simultaneous transport of ions and electrons. When I read Lynn Trahey's 2014 paper in the *Journal of the Electrochemical Society* on the development of the solid electrolyte interphase using electrochemical quartz crystal microbalance with dissipation (EQCMD) monitoring, I understood that a molecular-level understanding could be possible for my own materials. Over the next years, my group developed expertise in EQCMD, using the technique to reveal mixed ion and electron transport in nitroxide radical polymers for organic batteries. In parallel, I began to work closely with Micah Green and Miladin Radovic on the redox activity of MXene nanosheets. Around 2020, Michel Barsoum of Drexel University discussed a curious phenomenon observed with MXenes in certain electrolytes. It seemed that the best way to understand this phenomenon was to combine our lab's expertise in EQCMD with our growing work in MXenes. As Junyeong Yun explored different electrolytes, he began to see a pattern in that both cation and anion type affected energy storage. This was not expected, because the EQCMD work of Doron Aurbach's group in a 2015 *Advanced Energy Materials* article clearly showed that cations were responsible for charge storage. As we investigated a series of anions, we learned that the coupled interactions among the cation, anion, and water were influencing the charge storage mechanism. This is because for a cation to insert into MXene layers, it must break its interactions with both water and its complementary anion.

I hope that this vignette can show junior researchers how one's interests and expertise in different areas can wander over the years and then coalesce to yield a unique and interesting result with the help of friends and collaborators.

Jodie Lutkenhaus

IMPURITY TOLERANCE OF UNSATURATED Ni-N-C ACTIVE SITES FOR PRACTICAL ELECTROCHEMICAL CO_2 REDUCTION

Josh Leverett, Jodie A. Yuwono, Priyank Kumar, Thanh Tran-Phu, Jiangtao Qu, Julie Cairney, Xichu Wang, Alexandr N. Simonov, Rosalie K. Hocking*, Bernt Johannessen, Liming Dai, Rahman Daiyan*, and Rose Amal*

ACS Energy Lett. **2022**, 7 (3), 920−928 (Letter)
DOI: 10.1021/acsenergylett.1c02711

Particle and Catalysis (PartCat) research group members. Photo courtesy of Victor Wong.

I grew up in Medan, Indonesia. In the 1970s, we experienced regular power cuts and were forced to eat and do our homework by candlelight. It was a challenge. Until recently, I hadn't drawn the link between my childhood and my passion for harnessing the sun's power. During a conversation with my brother, he reminded me that, as a five-year-old, I had suggested we should catch sunlight and store it in a bottle so we could use it in the blackout.

Now, my research is about harvesting the sun's energy and using it to convert water, air, and waste to chemicals and fuels that we can bottle up. We're designing catalysts to harvest the wide spectrum of solar electromagnetic radiation. We can harness the photon energy—the ultraviolet—and visible radiation using a photocatalyst to convert it to chemical energy. We use the sun's heat—infrared radiation—to activate a thermal catalyst to make methane and methanol. And we indirectly use electricity generated from photovoltaic cells to activate the electrocatalyst to make hydrogen and ammonia.

I've experienced plenty of setbacks and challenges in my research career. When I was younger, I saw them as failures. But, as I gained more experience, I realized not to clutch goals too tightly—for the greatest opportunities are often unexpected.

What advice would I give to my younger self? Set ambitious but realistic goals. Do the best you can with what you have. And remember that life itself is a journey; enjoy every moment!

Rose Amal

IMPURITY TOLERANCE OF UNSATURATED Ni-N-C ACTIVE SITES FOR PRACTICAL ELECTROCHEMICAL CO_2 REDUCTION

Josh Leverett, Jodie A. Yuwono, Priyank Kumar, Thanh Tran-Phu, Jiangtao Qu, Julie Cairney, Xichu Wang, Alexandr N. Simonov, Rosalie K. Hocking*, Bernt Johannessen, Liming Dai, Rahman Daiyan*, and Rose Amal*

ACS Energy Lett. **2022**, 7 (3), 920−928 (Letter)
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Rosalie Hocking at the X-ray Absorption Spectroscopy beamline at the Australian Synchrotron. Photograph taken by Scott Saunders.

My research is focused on developing ways to characterize complex materials. A big focus of this is on applying analytical techniques, including synchrotron techniques, to assist in the design of new energy materials, including electrolyzers and batteries.

I completed my Ph.D. at the University of Sydney in 2004. It was supposed to be about synthesizing cobalt complexes for drug delivery. But I became interested in understanding how databases of crystallography data could enable us to infer information about structure and bonding in a predictive way. I am incredibly grateful to this day that my Ph.D. supervisor (Professor Trevor Hambley) let me write my Ph.D. on this topic. I don't know how I would react today if one of my students told me they didn't really want to work on the project they had been given and offered an alternative utterly unrelated to the original topic. My Ph.D. work in understanding covalency and bonding interested me in the extraordinary work of Professor Edward Solomon developing spectroscopic strategies to understand biological systems. I never imagined I would get a chance to go to Stanford and work on those systems. My postdoc was joint with Stanford Synchrotron Radiation Laboratory (SSRL), so I was also able to work with Professors Britt Hedman and Keith Hodgson. Having spent three years working on the theory of $L_{2,3}$-edge X-ray absorption spectroscopy (XAS). I wanted to find more applications for the X-ray techniques I had learned at Stanford. After returning to Australia, I held several contract research positions where I got a chance to apply synchrotron-based techniques to a diverse range of problems—from electro materials to soils to coal. The most interesting of these materials to me were the thin film electrocatalysts, where we found some materials weren't always what people thought they were. So when I got a chance to start my own research group in 2013, this became a key focus of our work.

I am currently a senior lecturer at the Swinburne University of Technology in Australia. Our work is about innovation through characterization. The importance of characterization is often overlooked across the innovation spectrum, but new strategies for understanding materials can change how we think about systems. This is critical, as we need to find ways to make our key commodity products like ammonia and acetylene without emitting carbon dioxide. Through studying many different electrocatalyst systems, we see commonalities that may help us understand the mechanism. For example, disordered metal oxide materials are very commonly observed in electrocatalysis; however, the functional significance of this disorder is not always understood. So we sought to understand this better and found substantial impacts beyond the surface area, including fundamental changes to stability and electron transfer properties.

While I have had the chance to work in extraordinarily well-resourced environments, I have also had the challenges of working in places with little access to infrastructure for characterization. This interested me in asking what we could take from the synchrotron techniques we have developed to make chemical and materials characterization more accessible for everyday people and businesses. So in parallel to my work developing ways to characterize energy materials, our group also works on developing new ways to make analytical characterization more accessible for everyday people and businesses.

Rosalie Hocking

■ UTILIZING NONPOLAR ORGANIC SOLVENTS FOR THE DEPOSITION OF METAL-HALIDE PEROVSKITE FILMS AND THE REALIZATION OF ORGANIC SEMICONDUCTOR/PEROVSKITE COMPOSITE PHOTOVOLTAICS

Nakita K. Noel*, Bernard Wenger, Severin N. Habisreutinger, and Henry J. Snaith*

ACS Energy Lett. **2022**, 7 (4), 1246−1254 (Letter)
DOI: 10.1021/acsenergylett.2c00120

Dr. Nakita Noel (center) with Dr. Jay Patel and Ms. Siyu Yan. Dr. Nakita K. Noel is an EPSRC Research Fellow and Group Leader (Department of Physics, University of Oxford). Photo courtesy of Nakita Noel.

Curiosity has always been an enormous motivator for me. Solving puzzles and learning how things work has always been fascinating to me—and that's how I became interested in science! During my undergrad, I was equally intrigued by both the mysteries of physics and the puzzles of chemistry, so instead of choosing one, I majored in both. This has allowed me a unique perspective on subjects where both physics and chemistry collide. One of those is the field of emerging absorber materials for photovoltaics (PV), most notably halide perovskites, where their rich materials chemistry impacts optoelectronic properties and, ultimately, device physics. The initial breakthrough in perovskite PV happened during my Ph.D. at Oxford, which was incredibly exciting, and it let me marry chemistry and physics research while contributing to something important—the fight against climate change.

Some bits of advice for younger researchers in the field:

- Science is a fundamentally collaborative endeavor. A good research environment fosters collaboration and connection instead of emphasizing individualism and competition. Consider this when choosing/building a research group.
- Find good mentors, and pay it forward by being a good mentor to others.
- Research is fun but sometimes hard and frustrating. Don't give up. Give yourself some emotional distance and tackle the problem again tomorrow. Sometimes all you need is fresh eyes.
- "You're never ready until you do it." One of my most honest and supportive mentors said this to me once, and she couldn't have been more right.

Nakita Noel

■ PROSPECTS FOR AEROBIC PHOTOCATALYTIC NITROGEN FIXATION

Yu-Hsuan Liu, Carlos A. Fernández, Sai A. Varanasi, Nhat Nguyen Bui, Likai Song, and Marta C. Hatzell*

ACS Energy Lett. **2022**, 7 (1), 24−29 (Letter)
DOI: 10.1021/acsenergylett.1c02260

Photo of Marta Hatzell. Photo courtesy of William Candler Hobbs.

As an undergraduate student in the Schreyer Honors College at Penn State, I had a thesis requirement for graduation. At that point in time, I knew I wanted to explore renewable energy and sustainability broadly as a profession. Thus, when Professor Matthew Mench (now Dean Mench) advertised an undergraduate research position in his Fuel Cell Dynamics and Diagnostics Lab (FCDDL), I jumped at the opportunity to join his group. I learned I would be working on examining water transport within polymer electrolyte fuel cells using neutron imaging. Unlike most undergraduate research experiences where the start may be slow, my experience had to be accelerated, as the lab needed extra hands for an upcoming trip to the newly opened National Institute of Standards and Technology (NIST) Neutron Imaging Facility (NNIF). So, for the first month of my undergraduate research, I worked with a senior Ph.D. student to learn everything I could about fuel cells, neutron imaging, and heat and mass transport. In my second month, I had the opportunity to travel with my PI and another graduate student to NIST. At NIST, we worked long hours alongside beamline scientists to examine temperature gradient-induced water transport.

While this experience was exhausting, it was also one of the most exciting experiences I had as an undergrad. I tied two things that I love together: (1) learning and (2) teamwork. The ability to work side-by-side with the other researchers toward a shared mission was motivating to say the least, and that was the moment that I knew I wanted to pursue a career in research.
Marta Hatzell

RECHARGEABLE METAL−HYDROGEN PEROXIDE BATTERY, A SOLUTION TO IMPROVE THE METAL−AIR BATTERY PERFORMANCE

Samira Siahrostami*
ACS Energy Lett. **2022**, 7 (8), 2717−2724 (Letter)
DOI: 10.1021/acsenergylett.2c01417

Profile photo of Samira Siahrostami at the University of Calgary. Photo courtesy of Samira Siahrostami.

My excitement has always come from seeking knowledge. I did my graduate education in physical chemistry in Iran, where I learned complex math and physics principles. I always excelled and enjoyed learning those heavy concepts, but I often pondered how to apply them to address real-world issues. This gave me the courage to embark on adventures and pursue postdoctoral degrees at the Technical University of Denmark and, later, at Stanford University. I picked up how to apply computational catalysis to energy research, and it became my mission to work toward transitioning to a sustainable energy world. I established my own research group at the University of Calgary in 2018.

I am fascinated by the H_2O_2 molecule and its applications in energy and the environment. To improve its sustainable and on-demand production, I pursued various research avenues. Some of my computationally predicted catalysts were commercialized (HPNow and PeroPure companies), for which I received the Royal Society of Chemistry's (RSC) Environmental, Sustainability, and Energy Division Horizon Prize: John Jeyes Award.

We are living in a world with a great need for energy supply. H_2O_2 is an alternative clean energy carrier to hydrogen. Recently, I presented a novel rechargeable battery concept based on H_2O_2 redox chemistry and demonstrated its advantages over rechargeable metal−air batteries. This technology has the potential to solve the long-standing issues with rechargeable metal−air batteries, which will have a significant impact on our energy sector.

Making game-changing discoveries requires creative thinking, a commitment to learning, and a willingness to take risks, as I have discovered throughout my career.
Samira Siahrostami

FACTORS LIMITING THE OPERATIONAL STABILITY OF TIN−LEAD PEROVSKITE SOLAR CELLS

Derya Baran*, Luis Huerta Hernandez, Luis Lanzetta, Soyeong Jang, Joel Troughton, and Md Azimul Haque
ACS Energy Lett. **2023**, *8* (1), 259−273 (Focus Review)
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Profile photo of Derya Baran. Photo courtesy: Carlos Xavier Vaula Pita. Taken by Anastasia Serin @ KAUST.

Energy has always been a puzzling concept to me. It is very stimulating and philosophical to think about what energy is, how it is conserved, or what it is transformed into. Although we cannot see it, we can feel it or use it and even harvest and convert it into different forms. No wonder why, then, energy harvesting and conversion was what I was drawn into as research. I have been working with functional semiconducting materials that can convert one form of energy into electricity using either light or heat, i.e., photovoltaics and thermoelectrics. My group looks into the potential of new and novel functional materials that can work in such energy devices and their stability, fueling a sustainable future using renewable energy resources.

One of the "aha!" moments in my career was when I and one of my postdocs (Dr. Nicola Gasparini, now a lecturer at Imperial College) realized that the organic photovoltaic device we were looking at had a peculiar transparency profile in the visible region. Along with this, the performance and stability were unique, which kept us looking at each other and thinking we should work on this toward scaling up for transparent energy-generating photovoltaics for controlled environment agriculture (CEA). This was the backstage story of our start-up, i.e., RedSea, which has now turned into a growth company globally with more than 60 employees working on the "feeding the world sustainably" challenge.

One of the biggest goals or dreams of a scientist is to have an impact, I believe. This is a statement I heard either from my students, postdocs, or even colleagues in mentorship sessions. Driving innovations and a positive impact toward a sustainable future via a slightly unusual academy/entrepreneurship route is such a satisfying feeling for me. My humble advice or suggestion to those who will consider an academic path with high enthusiasm for creating solutions would be to combine the best of the two worlds of academia and entrepreneurship. It takes a lot of energy and time, but it will all be worth it when you create your first product on the market or find an investor who firmly believes in what you are doing. So how do those magic ideas come to life? Although there are no magic hidden rules to it, there are some key elements:

- *Read!* And not just your area of research. Read what are the trends and issues globally and what are the pain points of real customers of your technologies, even if they are too early-stage.
- *Network with peers!* And not just with your department buddies. Reach out to wider student/postdoc communities from different disciplines to complement you and learn interesting and different approaches to solve your research problems.
- *Network with mentors!* Don't be shy about reaching out to professors at conferences or after talks. They can be as shy as you are to reach out. You can always develop a relationship that would later lead to lifelong mentorship.
- *Build your village!* As I always recall, "it takes a village to raise a child." It is the people around us and our decisions that make us happy, successful, or change-maker. Work toward creating a supportive environment that would be there for you in your worst and best moments and whatever path you would choose.

Derya Baran

THE PEROVSKITE DATABASE PROJECT: A PERSPECTIVE ON COLLECTIVE DATA SHARING

Eva Unger and T. Jesper Jacobsson*

ACS Energy Lett. **2022**, 7 (3), 1240−1245 (Energy Focus)
DOI: 10.1021/acsenergylett.2c00330

Photo of Eva Unger in the lab. Photo courtesy of Helmholtz-Zentrum Berlin Communications Department.

My earliest memory of being fascinated by science and technology dates back to my childhood: My mom explained how leaves, powered by the sun, consume carbon dioxide and produce oxygen and I wondered whether one could build a machine to mimic this process. After my undergraduate studies in chemistry at the University of Marburg, Germany, I was scouting for Ph.D. thesis research opportunities in applied energy conversion technology. I found one in the Hagfeldt group at Uppsala University, Sweden. The team was working on dye-sensitized solar cells (DSCs), which was, for me, an ideal cross-disciplinary research field between chemistry, physics, and material science on a "model system for photo-synthetic energy conversion". My research inspired me to develop an experiment box to bring the fun of making DSCs to school children. In 2012, I joined the McGehee group at Stanford University, California, USA, right when the perovskite solar cell (PSC) hype started.

What was most challenging during the early days of PSC exploration was to define reliable measurement procedures, as these materials exhibited transient electronic phenomena. Looking for opportunities to be able to explore the technological potential of PSCs, I started working as a guest scientist at Helmholtz Zentrum Berlin, Germany, where in 2017, I was given the opportunity to start a research group focusing on scalable solution-based methods for PSC manufacturing. Reliable scientific results and responsible research are essential to developing energy conversion technology to help solve the energy crisis. Therefore, I am engaged in data infrastructures enabling Open Science and FAIR data.

Eva Unger

BATTERY HAZARDS FOR LARGE ENERGY STORAGE SYSTEMS

Judith A. Jeevarajan*, Tapesh Joshi, Mohammad Parhizi, Taina Rauhala, and Daniel Juarez-Robles

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From left to right: Dr. Taina Rauhala, Research Scientist, UL Research Institutes; Mr. Toukir Hasan, Graduate Student, Purdue University; Dr. Judy Jeevarajan, VP and Executive Director, UL Research Institutes; and Ms. Maria Terese, Graduate Student, Purdue University. Photo courtesy of Judy Jeevarajan.

I currently lead the Electrochemical Safety Research Institute (ESRI) in UL Research Institutes (ULRI), as the vice president and executive director. I have been with the company for more than seven years. Before this, I worked at the NASA Johnson Space Center as a Research Scientist and then as the Battery Lead for Advanced Technology and Safety. At NASA, I carried out extensive research in the area of battery safety which helped me significantly in the responsibility I had to approve all batteries that were flown in space for human-rated applications. As a research scientist, I certified the first lithium-ion battery used for human-rated space flight. The device that used this battery was a camcorder used in the Space Shuttle. My research curiosity led to several interesting discoveries. The 18650 model of commercial lithium-ion cells is designed with internal safety controls that were physically present in the header region of the positive terminal of the cell. The positive temperature coefficient (PTC) provided protection against short circuits, and the current interrupt device (CID) provided protection against overvoltage hazards. My curiosity led to the findings that the PTC ignites when it is activated under high-voltage environments and also that PTC activation occurs at lower currents when the external temperatures are higher than ambient room temperature. I similarly found that the CID in the cells does not protect when a high-voltage/high-capacity battery is subjected to an overcharge condition. This has become an important factor to consider as we go from the low-voltage portable power requirements to the large kWh to GWh energy required in electric vehicles and stationary grid energy storage applications.

When I transitioned from the government to the private sector, it was only natural for me to join a company such as Underwriters Laboratories, whose mission is to make the world a safer place. At ESRI, our institute's goal is to advance safer energy storage through science. I have always had a passion for research, and my work has always been geared toward learning through scientific research. The number of women leaders in science has increased significantly in the past decade, and a commitment from women leaders to give opportunities to other women to grow scientifically is certainly required.

My advice to my younger colleagues and new hires is to make work interesting for yourself and use every opportunity provided wisely. And finally, with passion and perseverance, one can reach for the stars!

Judith Jeevarajan

■ UNDERSTANDING INTERFACIAL RECOMBINATION PROCESSES IN NARROW-BAND-GAP ORGANIC SOLAR CELLS

Nora Schopp, Hoang Mai Luong, Benjamin R. Luginbuhl, Patchareepond Panoy, Dylan Choi, Vinich Promarak, Viktor V. Brus*, and Thuc-Quyen Nguyen*

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Photograph of Professor Thuc-Quyen Nguyen (Director, Center for Polymers and Organic Solids, Professor of Chemistry and Biochemistry). Photo courtesy of Andy Le.

My interest in energy research traces back to my childhood. I spent 16 years in small villages in Vietnam, lacking basic needs such as drinking water, food, and clothing. Our homes also lacked electricity, making it impossible to work after sundown. I remember dreaming of capturing some of the sunlight during the day so that I could study at night. Such dreams were fueled by curiosity and creativity, and I always wondered how things work and wanted to understand the world around me.

At the age of 21, I immigrated to the United States of America with my family, knowing only a few words of English. At that time, I did not even know what research was, and my main goal was to learn English so that I could communicate with people. The very first laboratory course I took was general chemistry at Santa Monica College. I immediately fell in love with the practice of using chemicals, glassware, and intricate apparatus. I was always the last student to leave the lab because I wanted to do more experiments and learn as much as I could. I then transferred to the University of California Los Angeles (UCLA) and asked a dozen professors to let me do undergraduate research, but they told me research was not for everyone; I was told that I should focus on classes and learning English. It was not until the winter quarter of my senior year that Benjamin Schwartz took me in, and I decided to do my Ph.D. thesis under his supervision. I am forever grateful for his guidance and support. The more challenges I faced, the harder I tried. I used every setback and hurdle as a motivation to move forward, and 10 years after arriving in the U.S. with little English, I received a Ph.D. from UCLA in physical chemistry. However, I did not do research on organic solar cells until I started my own research group at the University of California Santa Barbara in 2004. I submitted a proposal to the Young Investigator Program Office of Naval Research (YIP ONR), Functional Polymeric and Organic Materials, managed by Dr. Paul Armistead, to investigate organic solar cell morphology. The ONR has been supporting our solar cell research ever since, and the dreams of my younger self to harness sunlight have started concretizing with every contribution we made to the field.

My advice for young people is not to let anyone, or any circumstance, stop you from pursuing your dreams and having a positive attitude. I also advise youngsters to stay open-minded and not to be afraid to walk away from their "comfort zone" and learn new things, especially in the area of scientific research, which has become increasingly collaborative and interdisciplinary.

Thuc-Quyen Nguyen

Virginia H. Keller, Journal Office Administrator, *ACS Energy Letters*

Sergey Shmakov, Managing Editor, *ACS Energy Letters* orcid.org/0000-0002-8713-4516

Prashant V. Kamat, Editor-in-Chief, *ACS Energy Letters* orcid.org/0000-0002-2465-6819

■ AUTHOR INFORMATION

Complete contact information is available at: https://pubs.acs.org/10.1021/acsenergylett.2c02727

Notes

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