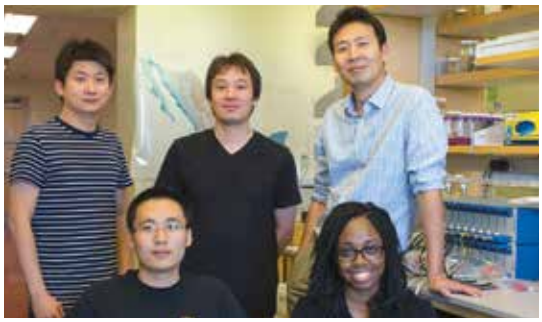
Young Faculty Profile: Professor Min Hwan Lee

PROFESSOR MIN HWAN LEE recently joined the School of Engineering fresh out of graduate school at Stanford University. Lee hails from South Korea. His research interests span the study and development of electrochemical energy conversion/storage devices, nanoscale electrochemistry, fuel cells, ionic batteries, resistive switching memory and scanning probe microscopy-based observations.

Lee describes his research and teaching mission, giving some insight into the way our young faculty members carry forward the university's mission of research beneficial to society, and how they help shape the culture of our campus.



What is your core research about?

One project involves the development of a totally new kind of electrode for making solid oxide fuel cells, one of the most widely employed fuel cell types. These cells have many advantages over other fuel cells: They accept hydrocarbons including natural gas and butane (not restricted to pure hydrogen), and are virtually free of other complications such as sensitivity to humidity and toxic contaminants, significantly reducing the overall system complexity.

However, SOFC are not practical for mobile and/or vehicular applications because of their reduced functionality at very high temperatures. The biggest challenge in reducing SOFC operating temperatures has been finding decent electrodes that operate at much lower temperatures.

Right now, we're testing carbon-based nano-structured materials as SOFC electrodes. Carbons weren't considered as catalysts for SOFCs before, because of their chemical instability in air at elevated temperatures. However, our recent studies using crystalline forms of carbon are very promising, and this has the potential to be a major breakthrough in the field.

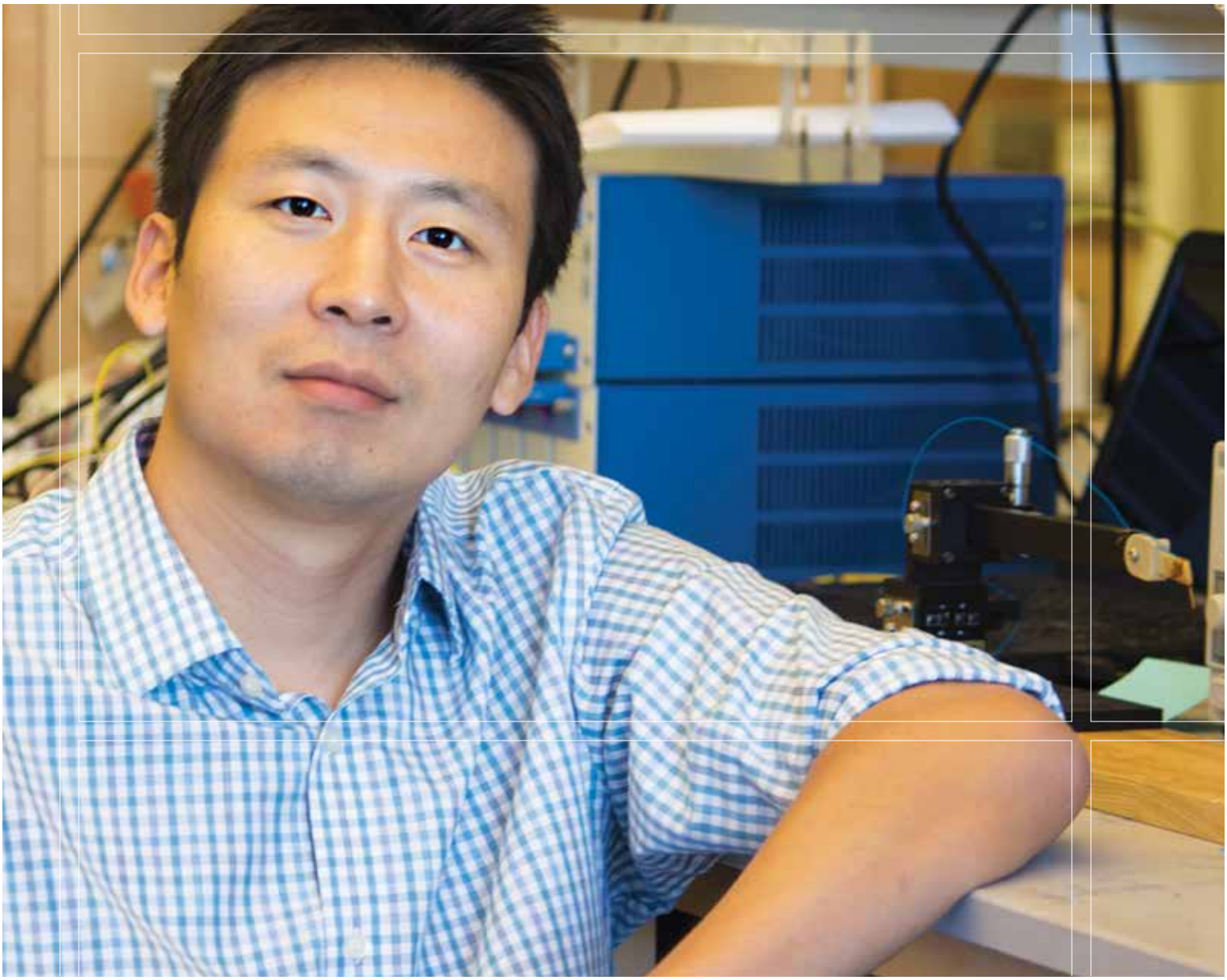
My lab also studies resistive switching memory, one of the most promising next-generation data-storage devices. Silicon-based flash memory is widely used as non-volatile memory, but further enhancements to speed and memory capabilities of flash drives is rapidly approaching physical and technical limitations. RSM is a promising alternative and has recently attracted significant attention because of its high speed, excellent scaling potential and low power consumption. My group is working to better understand the resistive switching behavior exhibited by RSM cells, which indicates their on and off states. We are working to establish a fundamental understanding of these processes.

What are your future projects?

We plan to pave a new way of making in-situ nanoscale observations of electrochemical reactions and charge-transport phenomena for energy devices such as solid oxide fuel cell and ionic batteries. SOFC and ionic batteries necessitate very high temperature and air-sensitive liquid environments, respectively. We will use atomic force microscopy, rigorous experimental design and custom-made probes to determine true nanoscale information on the electrochemical kinetics and charge transport in these systems. This project should significantly advance the current state of knowledge on these devices.

What is your teaching and mentoring philosophy?

I vividly remember how much I enjoyed and actively participated in classes that were well organized and structured. I believe the objectives of a class have to be clear to all students and the scope of the lecture needs to be well defined and prepared to facilitate learning. I also think classes should not limit the minds of those who are interested in further study. I tend to try expanding the academic interests of students by providing timely information on related materials and supporting their forays into relevant fields of science and engineering.



What is a typical workday for your group?

I think creativity and efficiency tends to be negatively influenced if work hours are too strictly managed, so I leave the decision to individual preferences. I myself prefer staying late at work. It is an old habit. Some members come late and work until early in the morning while some come and leave early. We have a group meeting every Friday and additional one-on-one weekly meetings.

As a young faculty member, what is your take on research at UC Merced?

UC Merced is a new research university in which many talented young faculty members are striving to do good research. We have many opportunities to work with other UC campuses, nearby national laboratories and industries. I love the vibrant atmosphere in a very quiet and calm location. Many groups render fruitful and high-impact outputs. The environment is great to do research and motivates you all the time.

Hobbies? How do you balance work and social life?

I have only been here in Merced since early last year. The lifestyle here is definitely much simpler than in Seoul. As a junior faculty member with a child and an expecting wife, I have a busy schedule. I have a 2-year-old son who started giving mouth to his thoughts, which I relish watching. I also love driving and this area is perfect for me to enjoy it. And recently, I have started pursuing my interest in the piano.