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CHEMISTRY AN ASIAN JOURNAL Editorial

50 Years as a Woman Chemist in South Korea

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A symposium entitled "The Past, Present, and Future of Female Scientists" was held at the 124th Korean Chemical Society Meeting in Changwon, Korea, on October 18, 2019. I was invited to speak at this symposium as a female chemist who has worked in academia along with two others from a research institute and industry, respectively. I gave a talk entitled "50 Years of My Life Devoted to Chemistry". I talked about my life at the college and graduate school and what kind of research and activities I have done as a university professor, how I overcame the bad research situation in Korea in the past, etc. Furthermore, I gave some advice to young faculty members and students based on my experience. Dr. Kueckmann, the editor of Chemistry-An Asian Journal, asked me to introduce the content of the talk in this editorial, and here I am presenting parts of it.

I devoted myself to studying chemistry and conducting chemical research for 50 years since I entered the department of chemistry, Seoul National University, in March 1967 as a college student until I eventually retired as a university professor in February 2017.

When I entered college in 1967, there were only three female students among 30 members in my class. In the past, people generally thought that science was inadequate for females. There were seven faculty members in the chemistry department, much less than about 40 at present. At that time in Korea, the college students often participated in political demonstrations, protesting against the government, and then the classes were often canceled, so we learned little in the college. Besides, I never thought of dedicating my life to chemistry, and thus did not do my best to study chemistry. In my second year at college, however, I met a young man as a classmate in a lab, and we wanted to get married after graduating from college. Since we could hardly get the approval of marriage from our parents, we decided to go to the U.S. together to pursue our Ph.D. degrees. We expected that they would approve our marriage once we had to leave the country together. For this, we both got admission from the University of Chicago, married at the age of 22, and went for the U.S. Since then, I had changed my maiden name, Myunghyun Paik, to Myunghyun P. Suh (MP Suh), which I have used as my international name in all my publications. In Korea, we keep the maiden name for our whole life regardless of marriage.

The Ph.D. course works and research at the University of Chicago was very tough and took five years since to complete. The goal of the Ph.D. program at the University of Chicago was to cultivate only world leaders. Therefore, students who were judged by frequent tests to be inadequate as world leaders had to leave the school. About 80% of the 46 classmates that entered the chemistry graduate school gave up their studies or moved to other schools, and only seven received a doctorate. In the first semester at the University of Chicago, a professor often gave us homework that entailed finding errors in papers from Nobel Prize winners. Through this training, I learned that mistakes could be present even in the articles of prominent scientists, which was a valuable lesson for me. To enter the Ph.D. program, we had to pass qualification exams within one year. In preparation for this, by reading many papers and books, I realized that people had superpowers of fully understanding a book within one night, and this belief became my strength throughout my life. The super psychic power comes when one desperately wants to accomplish something.

I chose Inorganic Chemistry as the major in the Ph.D. course because it was the hardest subject for me, as I did not learn it at the college and thus thought it worthwhile as a challenge. I got a baby boy in the 2nd year of the Ph.D. program and lived the most challenging life as a student, a wife, and a mother. Studying chemistry by overcoming all the difficulties, my great love and attachment to chemistry grew and have lasted my whole life. When an experiment did not go well in the lab, I had a dream of experimenting for the whole night, and sometimes I could not sleep at all for a few days.

Earning a doctorate in 1976, I returned to Korea in March 1977 to realize my dream of life. My dream was to elevate the level of Korean chemistry to an internationally high level since it was underdeveloped, and I hardly found papers published by Korean chemists in prominent journals. To fulfill this dream, I wanted to make domestic research internationally recognizable and foster competent disciples who could contribute to Korean chemistry.

However, at the time I became an assistant professor in 1977 at the Department of Chemistry Education, Seoul National University, the research conditions in Korea were appalling. The department had only a pedagogy master's course as the graduate program, and it admitted 5-10 graduate students each year. Thus, my lab could receive less than one graduate student each year. There was no research funding system either, and I had to spend my salary on purchasing chemical reagents, glassware, and small equipment. The Korea Science Foundation, which was founded only in 1982, started to fund a small amount of money each year and asked to submit a report every three months. Therefore, I spent much time writing research reports and new proposals. In addition, I had to teach

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more than 20 hours a week in the classroom. There were only one IR spectrophotometer, one UV/vis spectrophotometer, and one 60 MHz NMR spectrometer available in the whole department. Therefore, I focused on research topics that required minimal human resources and cost as well as simple equipment. They were based on "one-pot template synthesis" and "self-assembly" in which ideas and designs are most important. My students collected data at other institutions that possessed the needed instruments by traveling around the country. The research conditions improved as the Korean economy grew and particularly after I moved to the Department of Chemistry at SNU in 2000, and I was able to have quite expensive instruments and up to 8-10 lab members.

Here are the topics that I have worked on. 1) One-pot metal-template synthesis of macrocyclic complexes and studies on X-ray crystal structures, spectroscopic, electrochemical, and magnetic properties. 2) Synthesis of unprecedented monovalent nickel(I) macrocyclic complexes as single crystals and studies on X-ray structures and spectroscopic properties. 3) Synthesis of magnetic materials containing macrocyclic ligands. 4) Self-assembly of coordination polymers that have functions of molecular recognition and separation, ion-exchange, and gas storage/separation. 5) Novel findings of single-crystal to single-crystal transformations of porous coordination polymers on guest-removal, guest-exchange, and redox reactions. 6) Development of fabrication methods of metal nanoparticles (Ag, Au, Pd, Mg) in porous coordination polymers (PCPs) and metal-organic frameworks (MOFs) without using a reducing and stabilizing agent. 7) Development of various pore modification methods for hydrogen storage in PCPs and MOFs. 8) Synthesis of flexible PCPs/MOFs and development of pore modification methods for selective carbon dioxide capture. 9) Synthesis of nanosized CuS in MOFs for application as electrocatalysts in fuel cells.

The papers published as a result of these studies have been cited more than 12,300 times with an h-index of 54, as of December 31, 2019. However, the number of citations that exceeded 1200 times a year has been decreasing every year after my retirement from Seoul National University in 2014. In Korea, when scientists reach the age of 65, they are not allowed to maintain the lab and research staff and have to stop research activities. It is a great pity that I cannot live as a chemist for a lifetime in Korea.

Besides teaching and conducting research at Seoul National University, I have participated in various international academic activities. I have served as an international advisory board or an editorial board member of several major international journals, such as *Coordination Chemistry Reviews* (1997-present), *European Journal of Inorg. Chem.* (2000–2010), *Chemistry-An Asian Journal* (2014-present), etc. I also served as an associate member and a titular member of the inorganic chemistry division at IUPAC, 2002-2006, and 2006–2009, respectively. In particular, I gave about 170 plenary, keynote, and invited lectures at international conferences. During 36 years at Seoul National University, I supervised 40 masters and 10 Ph.D. students.

During my career at the university, I have tried to keep some principles. 1) Do the best, regardless of the conditions or outcomes. 2) Pioneer the untouched research area. 3) Publish only excellent results, like ceramic makers choosing only a few from hundreds of pottery and destroying the rest. 4) Write papers like making pieces of art; check the experimental data and repeat the experiments until the data are reproducible and accurate, and revise the manuscript until satisfaction. 5) Avoid vain honors, such as gaining influential positions or getting fame in the media. 6) Never compete with others but help budding scientists. 7) Educate students to be good scientists. 8) Overcome the shortage of time by reducing the time to sleep as a female chemist with three children (I have a habit of sleeping ca. four hours a day).

At present, I feel that my dream has come true. In other words, the level of Korean chemistry is now very high internationally, and I have contributed a part. There are many young chemists, in particular, many female chemists in the academic and industrial fields in Korea, and they are highly talented and active. They will prosper Korean chemistry and lead world science.

I want to give some suggestions to younger chemists working in Korean academia. (1) Please pioneer your field and conduct internationally advanced research instead of expanding or improving someone else's research. A scientist might be similar to a pop singer. Even though she pioneered a new field, she will become a lagging scientist when she continues to work on the same subject for many years. The scientist must continuously open up new areas. Here are some tips. i) Investigate carefully uncommon phenomena or unusual data obtained in the laboratory. Professor E. O. Fischer discovered ferrocene and

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won the Nobel Prize. However, he did not intend to synthesize ferrocene but investigated the unique product resulting from the synthesis of fulvalene and found a new sandwich-type compound. ii) Be flexible in thinking instead of sticking to existing concepts. iii) Make yourself involved in analyzing and interpreting the data, reading the reference articles, and writing papers instead of solely relying on graduate students or research staff. (2) Write papers that have a high impact, even if they are only a few, instead of publishing hundreds of common ones. (3) Try to write them without a mistake. If someone finds the wrong data or significant errors in one of your papers, he/she will not trust all of them. (4) Do not complain that the current research condition is not so good. It is superior to that in the past. I believe that a poor research condition is a potion leading to excellent research because it offers you a chance to come up with novel ideas that no one in a better situation can do.

University professors should also provide students with a good education so that they can perform their jobs successfully in society after leaving the lab. If a professor educates the students only for his laboratory, students might face difficulties in society. Modern society is commonly a division of labor, and we can often see that more than ten students are listed as coauthors in a paper. However, if a student keeps working on a minor field in the lab, earns a degree and then leaves the lab, he may be unable to solve various complicated problems encountered at work. Therefore, professors should offer the students lots of opportunities to gain as much knowledge and experience, and learn as many techniques in chemistry as possible so that they can successfully work in society.

The following is my advice to college and graduate students. Students should have a firm philosophy on why they do science. Do you do it for your happiness? What is happiness? I think that it has to do what you like and feel that you are contributing to society. To serve the community as a scientist, you should gain a variety of experiences, basic knowledge, and skills at school. You do not always have a chance to learn, so fully use the school days for learning and studying. Nothing is given free in life, and all the results depend on how much effort and passion you have paid.

Finally, I would like to introduce a Korean pastor's word. He says that there are classes in academics. The lowest level is the one that harms society for his honor and benefit. The intermediate level is the one that is good enough for himself, and the highest level is the one that benefits the neighbors and contributes to social development. I encourage you to keep the top attitude in your whole life.