

Report of Internship at Imperial College London (UK)

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Period: two months and a week (69 days) April-June 2018

Country: United Kingdom

Institute: Imperial College London

Supervisor: Prof. Sergei G. Kazarian (<http://www.imperial.ac.uk/vsci>)

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1. Research

During the stay in Imperial College London, which is one of the top-ranking universities in the world, from April to June in 2018, I continued my research in the laboratory of Prof. Sergei G. Kazarian, famous for vibrational spectroscopic imaging research. We first met each other five years ago when I attended International Conference as a bachelor student (B4). At that time, he mistakenly recognized me as a postdoc in somewhere, not a student. My research in Kyoto University is vibrational (near- and mid-infrared) spectroscopic imaging for polymeric materials. The motivation of the visit to his laboratory was to extend my knowledge by experiencing research of advanced vibrational spectroscopic imaging techniques because I have been belonging to the laboratory of polymer processing in Kyoto University. So, the primary objective was to learn spectroscopic imaging techniques as well as physically/statistically-based analytical methods of hyperspectral imaging data sets.

During the stay in Imperial College, I engaged in the research of evaluating vulcanization process of elastomer/nanofiller composite. Nanofillers have been attracting a great attention due to their good mechanical, thermal and electrical properties. Nanofillers affect vulcanization process of elastomers both in a good way and a bad way. To reveal the effects of nanofillers on the vulcanization, *in-situ* macro attenuated total reflection Fourier transform infrared (ATR-FTIR) spectroscopic imaging was introduced for real-time monitoring of vulcanization. Spectroscopic imaging techniques give chemical information from spectra as well as spatial information (morphology/distribution of substances). By analyzing time-resolved ATR-FTIR spectrum at each position, degree of vulcanization reaction and concentration of crosslinking agents were clearly visualized. It was shown that nanofillers affect reaction as well as diffusion of crosslinking agents.

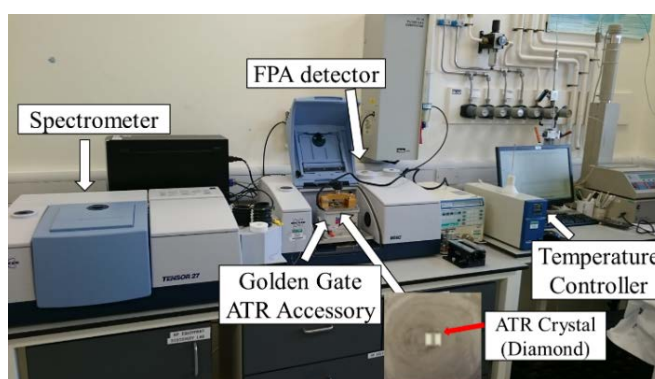


Figure 1 *In-situ* macro ATR-FTIR imaging system combined with a heating diamond ATR crystal.

2. “Diversity” — Cultural Differences in UK

In short, I frequently felt the “diversity” everywhere in London. For example, when I first visited to ICL, I had to register personal information to the online system of the university. There were so many branch conditions of selecting genders and sexual orientations with an option of refusal. In my whole life, I have never experienced such a registration that would cover gender diversity. When I went around the city of London, diversities of nationality, religion and the considerations to them were found in everywhere.

The concept of the diversity observed in UK also appeared in the system of Ph. D. course in Imperial College. One day, Prof. Kazarian and I discussed about the educational system and how to educate students. A huge number of students come to the Imperial College all over the world. Imperial College set several intermediate assessments after enrolling into Ph. D. course: (1) 2 months for research plan, (2) 8 months for progress of research, (3) 2 years for research achievements, (4) 3 to 4 years for Ph. D. dissertation. In these periods, several courses of professional education, including training of English skills for non-native students, are also offered in addition to the assessment of research. The reason why they set many stages of thresholds is early ascertainment of educational groundings of students. This leads to the advantage not only for staff of the university, but also for students to consider next career path. Welcoming people all over the world certainly increases the number of students abroad apparently and it seems to be globalized. Just an attitude of welcoming does not truly mean globalization for education. Discipline with the coverage of diversities in personal backgrounds is indispensable for achieving tolerance in the globalization.

3. What is Benefits of Experiences Abroad?

The answer to this question is growing up as a researcher and as a “person” in point of mentality. I fortunately have experienced the life in the following three different countries except attendances of international conferences.

- A) Germany: Technische Universität Dortmund, Department of Biochemical and Chemical Engineering (<https://www.ch.t.kyoto-u.ac.jp/ja/information/internship/2014/index.html>) August-September 2014
- B) USA: Massachusetts Institute of Technology (MIT), Department of Chemical Engineering and Department of Chemistry (<http://www.jgp-cche.t.kyoto-u.ac.jp/wp-content/uploads/2015/02/Report-by-Mr.-Shun-MUROGA.pdf>) March 2015
- C) UK: Imperial College London, Department of Chemical Engineering (This report), April-June 2018

The most notable difference of these three visits was differences of my position, master course (A and B) or Ph.D. (C). I perceived everything more critically and analytically than I did when I was a master student. As a doctor student, this led to the deeper discussion on everything. In the laboratory of Imperial College, my research experience was the longest among all members, except the professor. He asked me for teaching several things to other students in addition to my own research. Discussion with the students was a good experience for me to reconsider myself again.

From the viewpoint of English skills, speaking skills were significantly influenced by these experiences despite such short stays. To be honest, I was a stereotyped student with poor English skills of speaking and no private trip experience abroad. During and after the first experience abroad (A), I gradually lowered the threshold of saying something without any hesitation. Struggling to say a word instantly (NOT a writing a composition within my brain) played an important role in my changes. During the stay abroad, we talked about research as well as daily news, politics, economics, cultures, and social problems surrounding us. In conversations, subject of talking is changed in the blink of an eye. This was good training for quick output of my own opinions to everything in communication beyond gaps.

4. Acknowledgement

I would like to express my deepest gratitude to Prof. Kazarian for his support on everything in UK, not only the research in his lab at Imperial College, but also daily life in London. I was happy to be in his lab. I was glad to hear your words in the first week when asking me to continue research longer, not in a short period. It was regrettable that I could not extend my stay. When I concentrated on job hunting and deeply considered about career after graduation, he was kindhearted.

I am also grateful to all of members in Prof. Kazarian's lab. and my friends in Imperial College for supports of experiments and enjoyable university life. All people I met in Imperial College kindly gave me advices or become anxious when I faced on many private troubles, e.g. an accidental injury of myself in a party and accompanying to the hospital, becoming a victim of a criminal fraud, loss of money, urgent reschedule for temporal return to Japan during the stay in UK, a big earthquake hazard in Osaka.

I appreciate Japan Gateway Kyoto University Top Global Program Chemistry and Chemical Engineering Unit for the Top Global Course for kind support. I also wish to thank Dr. Yuta Hikima, the assistance professor of Materials Process Engineering Laboratory in Kyoto University for his sincere support on the procedures of visiting. It was impossible to go to Imperial College without his help.

This work was financially supported by Mazume Research Award of Graduate School of Engineering in Kyoto University for the expense of flight and living. I am deeply grateful to such a great financial support for investment to young students who would like to experience research abroad. Housing cost is particularly the most serious problem of all internship students I think. I had to pay £3,086, approximately ¥450,000 (without processing fees of payments) even in such a short stay. Food expenses are twice to three times more expensive than in Japan, for example, cost in a casual Italian restaurant (NOT exclusive restaurant with relatively cheap and bad-tasting cuisine) easily exceeds ¥2,500. Fortunately, cafeterias in Imperial College offer several kinds of foods (surprisingly including Japanese food) at relatively cheaper prices (£4-5) and coffee for free (limited to Ph. D. students and staff) so that I was able to save money. I manage to live in Japan with supports of Japan Society for the Promotion of Science (JSPS) Research Fellow DC1 in Ph. D. course, scholarship of Japan Student Services Organization (JASSO) and drawing of my saving (finally became almost zero in a first month of Ph. D.) little by little in bachelor and master courses after belonging to the lab. It was true that total costs of my stay in UK was higher than the current balance of my bank account. Money is inseparably related to research life, even if readers of this report may think that I am a money-grubber. Without such a great financial support, I did not have such a valuable experience abroad. If there is a student with financial problems (not limited to research abroad), my advice is as follows: please search scholarship or funding and apply them as much as possible, not to give it up.



Figure 2 A photo of Prof. Kazarian's lab. members in a party of celebrating the success of Ph. D. defense.