

Materials Science and Matsuri | 材料技術と祭

an experiential report
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Introduction | 序論

I knew before I even entered university that I wanted my undergraduate career to include some sort of experience abroad. But with the strict requirements of engineering courses and the non-standard co-op term sequence, an international exchange would be very difficult to accomplish. On the other hand, obtaining a paid foreign co-op position was also near-impossible on my own, as I did not have an international network or know where to look.

That's why, when I heard of the Canada-Japan Co-op Program (CJCP) through a friend, in which students are connected with employers willing to hire Canadian interns, I decided that I would apply as I was completing my third year. After several months of self-guided Japanese lessons, application forms, interviews, and phone calls, I was matched with my first-choice internship at Tokyo Gas, where I would be conducting research on the degradation of solar panel materials. A few more months of paperwork and emails later, I was off on a plane to live and work in Japan for eight months.

Tokyo Gas, established in 1885, is the largest city gas provider in Japan, operating in Tokyo and the surrounding Kanto area. In an effort to stay competitive within Japan's deregulated energy market, Tokyo Gas has been expanding its businesses to include related or supplemental forms of energy storage and production, such as fuel cell co-generation systems and, soon, solar panels.

Research and development for new technologies is mainly based at the Yokohama Research Institute, which is further divided between the Application Technology and Fundamental Technology Research Institutes. The latter deals with the sciences, such as thermodynamics, chemistry, and structural engineering, and their applications in Tokyo Gas' various operations. The team I was assigned with, Materials Science and Engineering, mainly conducts research on the lifetimes of materials used in any of the energy technologies.

First impressions | 第一印象

Tokyo Gas set me and the other CJCP student up with an “acceptance owner” (i.e. life supervisor) and our own “team leaders” (i.e. work supervisors). Our acceptance owner picked us up from the airport and helped us settle in to our apartments. They were small, but comfortable, stocked with all the appliances and utilities we would need (save for eating utensils). We had to pay the flat-rate utility bill every month, but it was reasonable for everything provided to us. In addition, my apartment had a balcony with a stunning view of the neighbourhood, presented below in Figure 1.



Figure 1. View from my apartment balcony on my first morning in Japan

Here I was in the south of Tokyo, thrown into a world I had only ever seen through animated TV shows and video games. One of the most difficult parts of adjusting was going grocery shopping — I spent at least an hour on my first trip to the store just translating the labels. Everything was overwhelming and distinctly Japanese, but not drastically different from what I was used to. Of course there were differences, including the language (I was nowhere near fluent), left-hand driving, and lack of sidewalks, but this wasn't the first time I was on my own in a big city.

Work | 職

We started work after a few days of organizing our residence cards and bank accounts. Not long after meeting our teams, receiving our uniforms, and being presented an overview of the company, I was given my initial laboratory task. I was taught to use the Fourier-Transform Infrared (FTIR) spectrometer, which is widely used for chemical analysis, in order to investigate the difference in degradation behaviour between thermally- and UV-aged polyurethane.

Over the next few months, I also evaluated the degradation behaviour of other materials. I conducted a literature study on the thermo-oxidative deterioration of cross-linked polyethylene pipes under pressure, research on thermally-aged acrylonitrile butadiene rubber, and began my main project analyzing the degradation of materials in aged photovoltaic modules, often juggling several of these projects at the same time. In the process I learned about Raman Spectroscopy, Differential Scanning Calorimetry (DSC), Thermo-Gravimetric Analysis (TGA), UV-Visible Range Spectrophotometry (UV-Vis), Scanning Electron Microscopy (SEM), and Energy-Dispersive X-ray Spectroscopy (EDX).

My mechanical engineering knowledge was useful for understanding the physical characteristics associated with degradation of materials (e.g. differences in fracture phenomena due to microstructural changes), or for knowing how to troubleshoot laboratory equipment issues (e.g. adding a seal to stop leaks in a humidifier). However, much of my work built on my foundations of high school and first year chemistry, and while I hadn't worked with such topics as organic molecule oxidation or stoichiometric analysis in a few years, I could recall them after some quick review.

On the other hand, the major aspects of research proved to be a challenge. My academic background is based in mostly macroscopic, applied science and mathematics, and my experience had consisted of actively designing things and solving problems. Conducting literature studies and reading papers to passively find information was not something I was very familiar with, and

compiling and summarizing material to guide my experiments took some time to get used to. Keeping track of all this information was also difficult initially, though eventually I learned best practices for maintaining an effective database, such as referencing adequately, writing brief outlines, and saving PDF files of papers to a specific folder.

Another matter that required strong organization skills was the data from my experiments. Almost all of the analysis methods had outputs in the form of data tables and graphs, and it was up to me to interpret this numerical information as qualitative changes in the materials. In order to do so, I needed to compare results between samples, by generating graphs and/or analyzing trends of certain values over time. Organizing data into spreadsheets was time-consuming and involved a lot of cross-referencing, but it developed my ability to work with large amounts of data and preemptively improve efficiency.

If I ever obtained unexpected results, I needed to find an explanation why. For example, the DSC results for the ethylene-vinyl acetate (EVA) encapsulant of the solar modules I was testing suggested that crystal structures formed or unformed over the aging process. (DSC shows melting and crystallization transitions of a polymer over changing temperatures.) After conducting more tests, my team and I discovered that there were, in fact, several other polymer layers, and it was their melting peaks that occasionally showed up in the EVA DSC data and were initially interpreted as EVA crystal melting. Such situations allowed me to enhance my ability to problem solve, especially from a non-mathematical perspective.

Overall, my placement exposed me to a much more science-based aspect of materials. I learned more chemistry and data analysis skills to supplement my engineering knowledge, which I believe is an asset in a world where it is becoming increasingly important to have interdisciplinary perspectives.

The laboratory experience I gathered will most likely open up more opportunities for me in the future, such as other research-based jobs or graduate programs, which are possibilities that I may not have seriously considered in the past.

Social | 社交

Of course, I did not spend all of my time at the office working with spreadsheets. My team made me feel welcome as soon as I started, and any preconceptions I had about Japanese people being shy dissolved very quickly. I am still not sure if the people at the Yokohama Research Institute are an exception, but most coworkers I met, from the beginning to end of my term, were very social and open (even if they didn't speak much English).

That being said, I did not find formalities at work, including hierarchal relationships, to be as evident at Tokyo Gas as I know they can be at other companies. The work style was not very different to what I was used to in Canada, as people still socialized while taking a break from their tasks, and communications between juniors and seniors seemed to be encouraged. In addition, partway through my term, the office switched to a uniform-optional, casual dress code, supposedly to boost comfort and creativity.

Conversations were slow at first due to the language barrier, which varied in intensity depending on the person. I spoke slowly, letting others get used to my accent and style of speaking. Explanations both ways were provided often, teaching each other vocabulary, pronunciation, figures of speech. I supplemented my immersion with brief, daily lessons (with the help of the app Lingodeer), so that I could properly learn grammar and sentence structure.

With time came comfort between the two languages. Before long, my coworkers were able to understand my English at a faster pace, and I was able to comprehend parts of their Japanese conversations. I became the resident English expert, helping a variety of colleagues with their papers,

presentations, and tests. I also sharpened my ability to gather the meanings of certain words and phrases without receiving a full translation or explanation — I am from a very multicultural part of Toronto, so I am used to less-than-fluent English — and this earned me the title of “best communicator in the world”, according to one of my team members.

On occasion, I was invited to dinners, industry expos, and day trips. We discussed differences between Canada and Japan — work environments, schooling, celebrations, activities, food, and pop culture, among many other topics. We shared stories from our lives, and found similarities. I developed friendships with those around me very quickly, and discovered that cultural bridges aren't hard to build once you can find an initial connection with someone.

Travel | 旅行

When I wasn't spending time at work or with my colleagues, I was mostly on my own. In an effort to make the most of living in Japan, I decided to spend every weekend exploring a new area within the country I hadn't been to.

I wanted my stay to include distinctly Japanese experiences, and so I centred many of my travels on *matsuri*, or festivals often based in Buddhist and Shinto traditions, something that evidently doesn't happen in North America. In fact, for my first weekend after settling in, before even exploring Tokyo, I decided to go to Osaka for the Kishiwada Danjiri Matsuri. Other festivals I attended were the Nihonmatsu Chochin Matsuri (Fukushima), Ikegami Honmonji Oeshiki (Tokyo), Sawara Aki Taisai (Chiba), Kawagoe Hikawa Matsuri (Saitama), Chichibu Yomatsuri (Saitama), Saidaiji Eyo Hadaka Matsuri (Okayama), and Omizutori (Nara), alongside more modern festivals such as the Sapporo Yuki Matsuri and Shikotsuko Hyoto Matsuri (Hokkaido).

Overall, in the span of eight months, I visited places in the following prefectures, in order of first visit:

- Osaka
- Tokyo
- Fukushima
- Kanagawa
- Chiba
- Saitama
- Kyoto
- Hiroshima
- Miyagi
- Yamagata
- Okinawa
- Iwate
- Nagano
- Gunma
- Hokkaido
- Ishikawa
- Gifu
- Okayama
- Aichi
- Nara
- Yamanashi
- Fukuoka
- Nagasaki
- Kumamoto
- Tochigi
- Ibaraki

This was the first time I was organizing trips entirely by myself, and I must say that while some trips went very smoothly, others were much more stressful. There were instances when I got on the wrong bus, booked a hotel in an inconvenient location, spent too much money on admission fees, overlooked a major sightseeing spot, or bought a useless train ticket.

At the same time, however, I sought blessings from the most beautiful shrines and temples, walked back in time through castles and historic districts, tasted some incredibly delicious food, beheld a variety of traditional art forms, and visited places that touched my soul. I witnessed some of the best parts of the country's autumn, winter, and spring seasons, and observed subtle differences in Japanese regional cultures. Just a few of these experiences are captured in Figure 2.

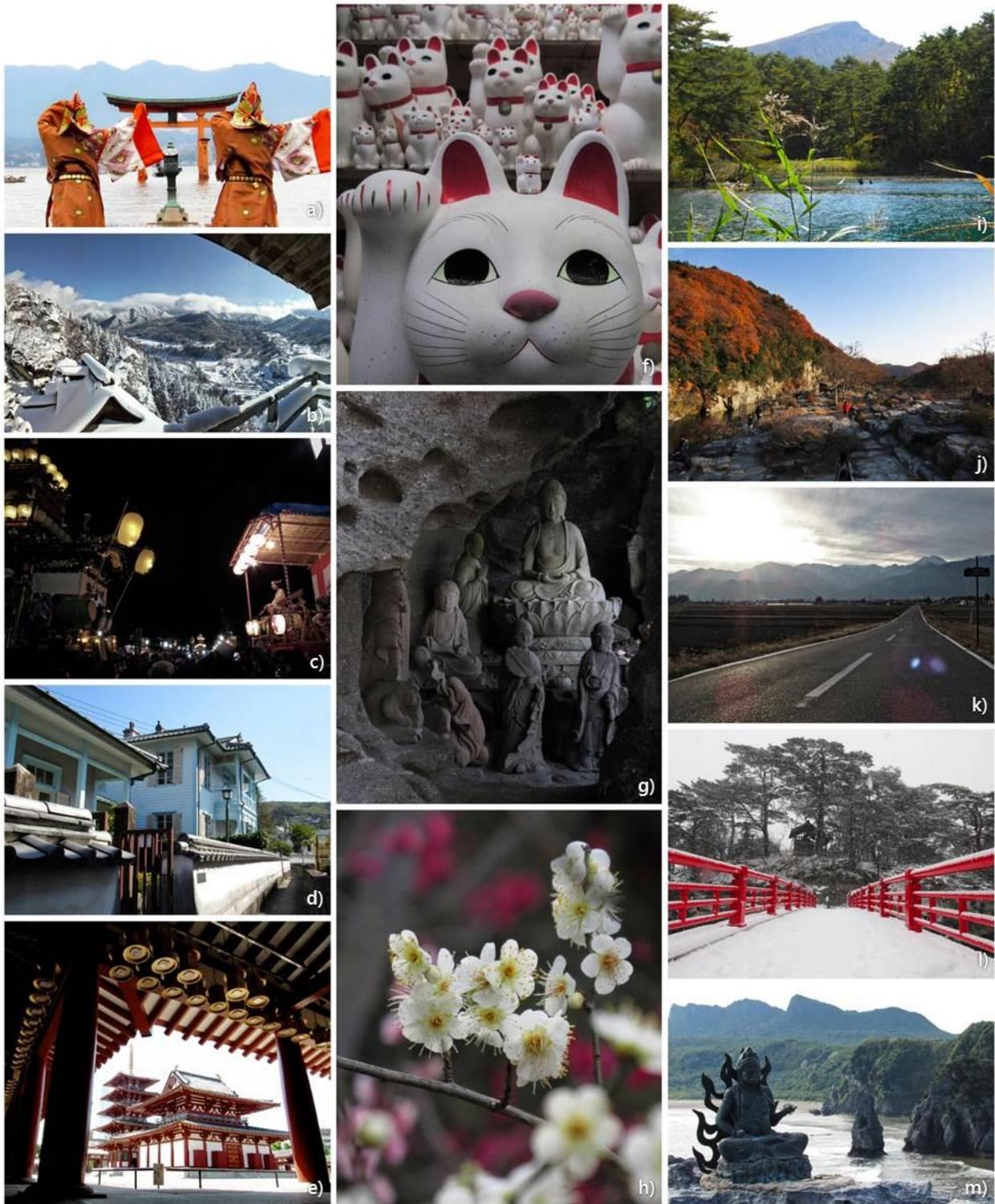


Figure 2. Photos of some of my favourite places or experiences in Japan: a) Itsukushima Shrine, Hiroshima; b) Yamadera, Yamagata; c) Kawagoe Matsuri, Saitama; d) Dutch Slope, Nagasaki; e) Shitennoji, Osaka; f) Gotokuji, Tokyo; g) Nihonji, Chiba; h) Korakuen plum blossoms, Okayama; i) Urabandai, Fukushima; j) Nagatoro, Saitama; k) Hida Mountains, Nagano; l) Matsushima, Miyagi; m) Hedo Misaki, Okinawa

Perhaps one of my favourite things about traveling was the people I interacted with along my journey. As I usually travelled by myself, Japanese people around me often took the opportunity to ask me where I was from, and what I was doing in Japan. People were amazed at my Japanese accent (despite my limited speaking capabilities), the fact that I looked South Asian but was born in Canada, that I was living in Tokyo for eight months, or that I made the effort to visit their hometown. Interactions included a kind old librarian who walked me partway to a train station, a restaurant owner who gave me an origami sculpture along with my meal, a pastry chef-physiotherapist who once did his clinical rotations in Toronto, a group of high school boys who half-included me in their chat over dinner, and a little kid who wanted to practice the few phrases he knew in English. Along with countless other conversations, pieces of guidance, and random acts of kindness, these reasons are why I now think that the common notion of Japanese people being shy is a myth.

Conclusion | 結論

Eight months is a perfect amount of time to get acclimatized to a country like Japan. Before long, I became accustomed to the mannerisms of the people around me, started thinking partially in Japanese, learned to cook simple local meals, and found myself giving advice to other CJCP students, both familiar and unfamiliar with the ways of the land.

Occasionally, we would meet up (like the time pictured in Figure 3) and share anecdotes and concerns with each other. It was interesting to see how different our experiences were, in terms of what our work placements were like, who we interacted with, what we did in our free time, and what we wanted out of this internship program.



Figure 3. CJCP get-together in September 2018

For any future CJCP students, my advice is this: you are going to come across challenges, but you will overcome them as long as you have an open mind and positive outlook. Learn from everything around you, but more importantly, learn from your mistakes. Use your support system when you need it, but set your own goals and aspirations. Ultimately, your experience in Japan is entirely what you make of it — and I hope it's as wonderful (whatever your definition of wonderful is) as my time here was.