Report on MERIT Long-term Overseas Dispatch Program

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Abstract of my research project

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Research Institute: Institut Néel, Grenoble, France

Supervisor: Dr. Bertrand Menaert

Research Project: Single Crystal Growth by Flux Method

(1) Research

Institut Néel is a research laboratory which is originated from Louis Néel, who is a Nobel Physics Prize laureate. In Grenoble, there are a lot of research institutes, like ESRS, CEA, and MINATEC. Therefore, Grenoble is a city similar to Tsukuba in Japan. In fact, Grenoble and Tsukuba have been sister cities since 2013, and in Grenoble, I met some doctor course students at Tsukuba University.

Pic.1. The building of Institut Néel where I actually made an experiment

My research purpose is to grow large single crystals by flux method. When physical properties of a material, like magnetization, electric polarization, are measured, it is necessary to prepare a sample large enough to a show significant response. The signal of these properties depends on the area or volume of the measured sample. Therefore, if we can successfully grow large single crystals, that should make various kinds of measurement possible. Especially, to explore magnetic properties of magnets, neutron diffraction is very powerful method. However, large size of sample is necessary to obtain enough diffraction intensity and measure for as short time as possible in neutron experiment. I could obtain crystals of the magnet of a few micrometers of square which I am investigating, but this size is not large enough to be used for such measurements. In Dr. Menaert's group, large single crystal growth by flux method is researched. The building where the experiment is performed has very fiber structure to the noise, like vibration. Thus, we can precisely carry out physicochemical measurement, such as surface tension and solubility, to explore the condition for crystal growth. Furthermore, this group also focuses on crystal growth method which is considered for chiral or polar domain structures, which is important for physical properties. In my laboratory, the research on material functions based on symmetry breaking is focused, so I'm interested in such an approach.

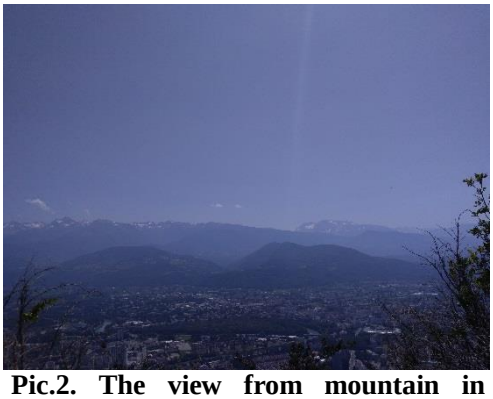
In the institute, I progressed my research with Dr. Menaert and Dr. Pena's instruction and we

discussed before and after an experiment. At first, we planned to find out good flux for the target material and grow large crystals by top seeded solution growth method. Unfortunately, I finished my stay at the stage of searching fluxes. That's because the target material reacts with alkali compounds which are often used for flux method and also it is likely to be decomposed at high temperature. However, I could try a lot of fluxes and as the result, we found some possible flux combinations. Even after my stay, Dr. Menaert allowed me to investigate this flux method together and improve the experiment by discussing with this group.

On the other hand, as a collaborative research, I performed surface tension measurement for the liquid in flux method at high temperature. In this stay, I could not measure one of the liquid including my target material, but I learned this method and will try to use this method for crystal growth.

(2) My life in Grenoble

Grenoble is a so-called basin, surrounded by mountains and one of the hottest city in France. Since there is no air-conditioner in most houses in France, I suffered from the lack of it in my stay. On the other respect of the environment, it is impressive that a lot of people tend to exercise, especially running. I also enjoyed hiking on holiday (Pic.2), and I did running with my supervisor when I was in the institute.



Pic.2. The view from mountain in Grenoble

I also had a verbal problem. In France, of course, people usually speak in French. I often could not understand the talk with the Internship students when we were eating lunch. Thus I was made acutely aware of the word "When in Rome, do as the Romans do".

In my stay, I could have an opportunity to enjoy some festivals, for example "Fête des Tuiles" in which people display and sell antiques or play a board game or table tennis, "Fête de la musique" which is a music festival in France in which people play or enjoy music by midnight, and firework for the Bastille Day. And in this year's Soccer World Cup, French team won the championship and people exulted in the victory. I experienced French life also for such festivals.

Acknowledgement

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