STEPS Students Report

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I had the science internship on Department of chemistry in University of Tokyo. My research was mainly under the leadership of Marie Yoshikiyo and Asuka Namai. They helped me to organize my experiments and process data.

In the laboratory of Shin-ichi Ohkoshi I synthesized nanoparticles of iron oxides by two methods: sol-gel method and reverse-micelle process. Varying the temperature of sintering I received different patterns of ferrits that had different size of particles and color. The process of the synthesis was quiet long and consisted of mixing of solutions, centrifugation, washing, drying and many others. For example, the ε-Fe_2O_3/SiO_2 composites were prepared by combination of reverse micelle and sol–gel methods. Centyl trimethyl ammonium bromide (CTAB) was used as the surfactant for the samples. During my work in the lab I have synthesized about twelve different patterns.

The entrance to the Department of Chemistry

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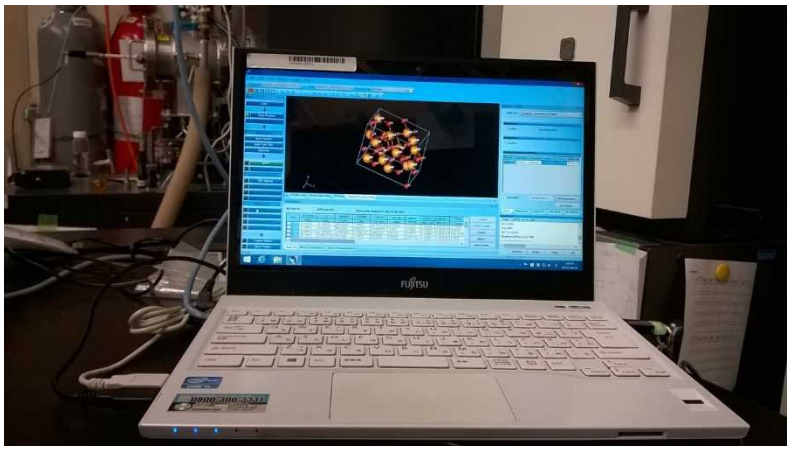
Measured samples of iron oxides (different phases)

To study magnetic properties SQUID measurements were used, I took hysteresis loops for all patterns and found important characteristics such as coercive field, magnetization and remanent magnetization. I studied how to prepare the samples for SQUID and use this device for work.

Magnetic measurements were used in combination with X-ray powder diffraction methods. XRPD patterns of the samples show a crystal structure of the sintered nanoparticles and the precursor. The structure corresponds to the phases of the iron oxide which differ by the ratio of the different size particles and a sintering temperature. I knew how to get X-ray spectra but I have never measured spectra of iron oxides. The main interest was in fitting these data to theoretical spectra. For this purpose I made analyze in PDXL 2 software.



The processing data (studying of the structure)

As follows from our analysis, gallium-substituted iron oxides display enough large coercive field (about 5 kOe) still we have a small size of the particles (less that 12 nm). So, the

conjunction of magnetic measurements, TEM images analyze and XRPD method allows us to reach a compromise on the issue "a small diameter of particles – a large coercive field". It is very important for magnet recording, electromagnetic filters and other applications.

Herein, I studied the synthesis, crystal structure, magnetic properties and first-principles calculations. Some of the samples such as ε-$Ga_{0.2}Fe_{2-0.2}O_3$ have been investigated for the first time.