

Stay report



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I am very thankful that I was able to do my external internship at Kyoto University. I am especially grateful of Professor Ono and Tanaka-san for helping me throughout my stay. I learned a lot about current advances in the field of spintronics. My own research was on the topic of magnetic memory devices. Recently Professor Ono suggested a new design for three-dimensional domain wall memory, which uses alternating bit and domain wall layers. In this way, domain wall position and thickness can be precisely controlled, which is a large obstacle in current designs for domain wall memory. Since the development of the device is still in a very early stage, the experiments were done with single-bit devices. We tried to achieve writing behavior in this simple device using spin-orbit torque from a platinum bottom contact. In previous experiments this has not worked consistently. In this experiment, a synthetic antiferromagnet is used as a reference layer. This way we can investigate the effects of the stray fields in switching. Using the anomalous hall effect to measure the spin-dependent resistance, we were successfully able to switch the magnetization of the cobalt platinum writing layer. But there were still quite a number of devices that do not show good hysteresis loops. It is speculated that this is due to manufacturing errors. In addition to these experiments, simulations were carried out. These were done on a newly suggested device that utilizes spin-transfer torque to write information, rather than the spin-orbit torque. In this way, the writing current is applied through the pillar, instead of perpendicular to it. This structure uses only two contacts, compared to three. And this reduces the number of transistors required and therefore the cost and space needed for the device. The difficulty in this device, is the balancing of currents to write magnetic information, and currents to move domain walls through the pillar. Ultimately, it has been found that it is possible to create a device that can perform both actions without interfering too much. More research is required to fully comprehend the behavior and to improve the parameters. And of course, I spent a lot of my free time exploring the country. This includes trips around the Kansai area, Shikoku, Kyushu, Hokkaido, Biwa, and many more locations. It was overall an unforgettable experience filled with incredible moments. Thanks again to everyone at Ono lab for helping me throughout my internship.

