

Spin Dynamics in Inhomogeneously Magnetized Systems

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Worldwide efforts are underway to create revolutionary and energy-efficient data storage technology such as magnetic random-access memory (MRAM). An understanding of spin dynamics in inhomogeneously magnetized systems is indispensable for further development of nanoscale magnetic memory. This lecture provides a clear picture of inhomogeneously magnetized systems, such as magnetic nanowires with domain walls and disks with magnetic vortices, and presents not only technological developments and key achievements but also the unsolved puzzles and challenges that stimulate researchers in the field.

First, the basic concept of an inhomogeneously magnetized system is described by introducing a magnetic vortex structure in a magnetic disk. A magnetic domain wall in a magnetic nanowire is also provided as a typical example. The magnetic field-driven dynamics of these inhomogeneously magnetized systems are described to illustrate their uniqueness. Second, electric-current-induced dynamics of magnetic vortices and domain walls are described. One can flip the core magnetization in a magnetic vortex using electrical current excitation, and move a domain wall by current injection into a wire. The next part focuses on the applications of current-induced magnetization dynamics in devices. The basic operations of two kinds of magnetic memories—magnetic vortex core memory and magnetic domain wall memory—are demonstrated. The lecture describes not only the current understanding about inhomogeneously magnetized systems, but also unexpected features that have emerged. It concludes with prospects for future developments.

Biography

Teruo Ono received the B.S., M.S., and D.Sc. degrees from Kyoto University in 1991, 1993, and 1996, respectively. After a one year stay as a postdoctoral associate at Kyoto University, he moved to Keio University where he became an assistant professor. In 2000, he moved to Osaka University where he became a lecturer and an associate professor. Since 2004, he has been working at Kyoto University, where he is now a professor. He has published over 280 technical articles in peer-reviewed journals, including book chapters and review articles, and has given more than 90 invited presentations at international conferences. He served as conference co-chair of the 8th International Symposium on Metallic Multilayers (MML) in 2013, and on the program committees of various international conferences on magnetism and spintronics. He is a member of the IEEE Magnetics Society and is an editor of the Japanese Journal of Applied Physics.