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Spin dynamics in non-collinear spin structure

T. Ono[1,2]

[1] *Institute for Chemical Research, Kyoto University, Kyoto 611-0011, Japan*

[2] *Center for Spintronics Research Network (CSRN), Graduate School of Engineering Science, Osaka University, Osaka 560-8531, Japan*

E-mail: ono@scl.kyoto-u.ac.jp

Worldwide efforts are underway to create revolutionary and energy-efficient data storage technology such as magnetoresistive random access memory (MRAM). An understanding of spin dynamics in non-collinear spin structure is indispensable for further development of nanoscale magnetic memories. This talk provides a transparent picture of spin dynamics in non-collinear spin structures in ferromagnets, 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.

The basic concept of non-collinear spin structures is described by introducing a magnetic domain wall in a magnetic nanowire [1]. A magnetic vortex structure in a magnetic disk is also provided as a typical example [2]. The magnetic field-driven dynamics of these non-collinear spin structures are described to illustrate the uniqueness of this system.

Then, the electric-current-induced dynamics of domain walls and magnetic vortices are described. One can move a domain wall by current injection into a wire [3-6], and flip the core magnetization in a magnetic vortex using electrical current excitation [7]. The applications of the current-induced-magnetization dynamics in devices, such as magnetic domain wall memory [8] and magnetic vortex core memory [9], are also presented. The impacts of spin-orbit torque and Dzyaloshinskii–Moriya interaction on the spin dynamics in non-collinear spin structure are also discussed [10, 11].

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