Development of the rectifying device for spin dynamics using asymmetric potential

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【Outline of survey】

Brownian motion of mesoscopic particles is ubiquitous and usually random. But when the periodic asymmetric saw-tooth shaped potential barriers are formed, directed or rectified motion can arise in the random system. This type of transport found in the intake of nutrition and the excretion of waste matter at the cellular level is well known as a molecular motor.

In this research project, we focus on the above principle of the potential ratchet characteristic of biological systems. The main goal is to establish the method to manipulate the motion of nano-scale magnetic domain walls and the polarization of conduction electron spins by replacing a source of driving force typically thermal agitation for biological systems with modulated magnetic field for nano-domain walls and modulated electric field for rectification of the conduction spins. Furthermore we aim at developing theoretically and experimentally a new paradigm for next generation magnetic devices such as a spin logic gate, a spin pump, and a spin lens.

【Expected results】

To meet all the demands of ubiquitous network society, new principles for large information storages and high speed communication technologies are highly expected. This research project is considered to give a significant contribution to the above demands. The rectifying device for spin dynamics in this study enables us to control effectively the motion of domain walls as well as both charges and spins of electrons. This will lead to the new magneto-electronic devices based on the new paradigm in the 21st century unlike electronic devices.

【References by the principal researcher】

1. “Current distribution inside Py/Cu lateral spin-valve devices”, J. Hamrle, T. Kimura, and Y. Otani, *et al.* Phys. Rev. B **71**, 094402 (2005).
2. “Suppression of spin accumulation in nonmagnet due to ferromagnetic ohmic contact”, T. Kimura, J. Hamrle, and Y. Otani, Appl. Phys. Lett. 85, 3795 (2004).

【Term of project】 FY 2005 - 2009

【Budget allocation】 61,600,000 yen

【Homepage address】 http://www.riken.jp/lab-www/nanomag/indexjpn.html