Numerical analysis on the spin-motive force induced by the resonant motion of a magnetic domain wall

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Changing of magnetic flux induces an electromotive force, known as a Faraday’s law. Recently, it has been pointed out that the changing of non-uniform magnetic structure in a ferromagnetic metal induces the spin-dependent force acting on the conduction electrons through a spin Berry phase [1]. This spin-motive force (SMF) has been observed in many systems [2,3] that opens a new way of manipulating spins in spintronics devices. Here, we study numerically the SMF induced by the resonant motion of a magnetic domain wall (DW) by applying an oscillating magnetic field. We have simulated the dynamics of a single DW in one-dimensional Permalloy (Ni$_{1-x}$Fe$_x$) system by solving Landau-Lifshitz-Gilbert equation using fourth-order Runge-Kutta method. We found that spatial configuration of the resonant oscillating mode of the DW depends on the direction of the oscillating magnetic field. We show the SMF induced by each resonant DW motion and discuss the possibility of the observation in actual experiments.


Schematic view of the SMF induced by the DW motion in Permalloy nanowire. An oscillating magnetic field is applied to the system. Each cone shows the magnetization vector in each cell.