TbFeCo 細線中に生成したバブル磁区の電流駆動現象の組成及びキャップ層依存性

Composition- and cap-layer-dependence of electric-current-induced dynamics of bubble domains in TbFeCo wires

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Electric-current-induced movements of domain walls in magnetic wires are paid attention because of the curiosity from fundamental physics and their potential as new spintronics devices. Some researchers have claimed that the reverse or transverse forces with respect to the electron flow are induced in the current-induced movements of the domain walls by the spin Hall effect or Rashba effect. In this presentation, we investigated the current-induced dynamics of bubble domains, which allow us to estimate these forces accuracy, in ferrimagnetic TbFeCo wires with transition-metal-rich and rare-earth-rich sides of the magnetization with different cap layers.

TbFeCo wires of about 10 nm in thickness with cap Pt and Ta layers of 2 nm were fabricated on thermally oxidized Si substrates using electron-beam lithography, sputtering and a lift-off method. The width of the wires was designed to be about 40 μm. Wires with two different TbFeCo compositions, whose magnetizations were transition-metal-rich and rare-earth-rich sides, were prepared. Bubble domains were induced in the wires using laser annealing with applying an external magnetic field. The current-induced dynamics of bubble domains was observed by polar Kerr microscopy at room temperature.

Figure 1 shows a bubble domain in the TbFeCo wire with the transition-metal-rich side of the magnetization with a Pt cap layer after an application of ten pulsed currents of 4.7×10^{10} A/m^2 in a perpendicular magnetic field of 350 Oe. The bubble domain grew to the electric current direction with an oblique angle of the left side. On the other hand, a bubble domain in the TbFeCo wire with the rare-earth-rich side of the magnetization with a Pt cap layer grew to the electric current direction with an oblique angle of the right side. We discuss the composition- and the cap-layer-dependence of electric current induced dynamics of the bubble domains.

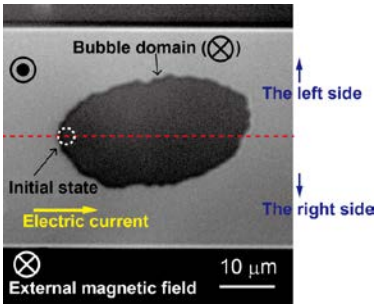

Fig. 1 The polar Kerr microscope image of current induced dynamics of the bubble domains in a TbFeCo wire with the transition-metal-rich side of the magnetization with a Pt cap layer.