Current Driven Domain Wall Motion in Compensated Ferrimagnets: Fast Domain Wall Velocity in a Wide Temperature Range Without External Magnetic Field

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Spintronics applications are being extensively followed for high-performance logic computing technologies and racetrack memories[1]. The principal difficulties are to reach small bits, high thermal stability, and track them at high speed. Although there is a report that the domain wall moving speed is improved by using the angular momentum compensation of RE-TM[2], as regards stable driving over a wide temperature range has not been achieved. In this work, we designed $Gd_x(Fe_{88}Co_{22})_{100-x}$ magnetic wires to to achieves great domain wall motion over a wide temperature range.

We prepared the following film stacks using rf and dc magnetron sputtering: Pt (5)/ Gd_x $(Fe_{88}Co_{22})_{100-x}$ (20)/SiN (10), the films are grown at the room temperature. The magnetic wires (3µm wide and 125 µm long) and Hall crosses were micro-fabricated by an Electron-beam lithography (EBL) system and a lift-off method. Subsequently, we measured the domain wall velocity. We applied a single voltage pulse and then observed the DW motion by using a Kerr microscope. The velocity of the domain wall was determined by dividing the change in the position of the domain wall by the duration of the current pulse. Figure 1(a) shows our measurement result in the Pt (5)/ Gd_{24} $(Fe_{88}Co_{22})_{76}$ (20)/SiN (10) sample as a function of current density. As a result, without applying an in-plane external magnetic field, the fastest DW velocity of 2000 m/s has been obtained as far as we know in the reports. Figure 1(b) shows the DW velocity of the $Gd_{24}(Fe_{88}Co_{12})_{76}$ as a function of operating temperature. DW speed obtained stable between the temperature range of R.T. $<T_{op}<$70°C for $Gd_{24}FeCo_{76}$ when pulse current of 30nsec and 3nsec is injected into the wire.

As a result, a wide temperature range with a DW velocity of 1500 m/s has been obtained in $Gd_{24}(Fe_{88}Co_{12})_{76}$ for a short pulse current which is more stable in comparison with the previous reports[3].

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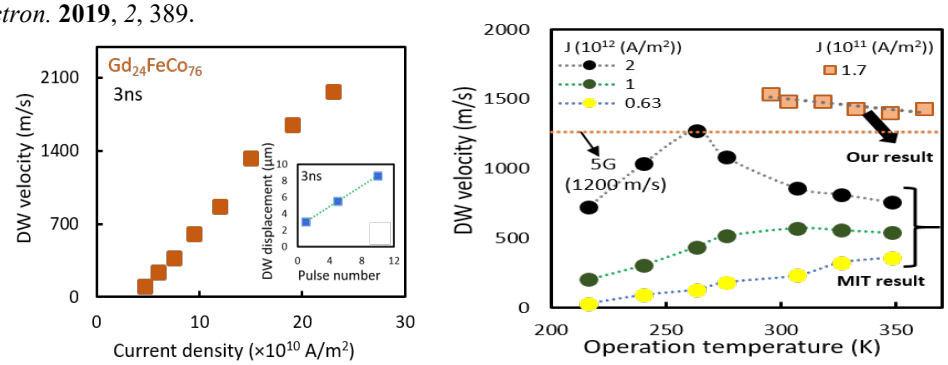

Figure 1.(a) Domain wall velocity as a function of current density with pulse duration 3 ns for $Gd_{24}FeCo_{76}$/SiN wire, (b) DW velocity as function of operation temperature for GdCo[6] (MIT result) and GdFeCo wires (our result).