Current induced domain wall motion in TbFeCo alloys with various magnetizations

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Reducing the threshold current J_{th} of domain wall (DW) motion induced by spin transfer torque in perpendicularly magnetized nanowires is of technological importance, especially when only small current sources are available to drive the DW devices. In Co/Ni multilayers in which J_{th}~40 MA/cm^2, it has been shown that J_{th} is determined solely by the intrinsic energy difference between Neel and Bloch DW configurations [1]. By using materials having lower magnetization (Ms) than Co/Ni multilayers, e.g. amorphous TbFeCo ferrimagnetic alloy, smaller energy difference is expected [2]. In Tb alloys, J_{th} of 5 MA/cm^2 has been reported [3], while the influence of extrinsic DW pinning [4] has been shown [5].

In this report, we discuss the role of Ms on J_{th} in wires made of amorphous Tb alloys of various compositions, in which Ms range between 35 and 150 emu/cm^3. To avoid etching damages to the magnetic materials, we directly deposited 9 nm thick Tb alloys wires on 2 µm wide Alumina bridges; we expect the properties of wire's films unaltered from the ones of plain films. We then measured DW velocities v–J (Fig.1), from which we extracted the current corresponding to the onset of DW motion by current J (Fig.2).

With the same fabrication method for the Co/Ni and Tb alloys wires, we obtained current values similar to literature (Fig.1). In Tb alloy wires, we obtained decrease of J_{th} when decreasing the Ms (Fig.2). Independent measurements of the DW pinning-strength a_H from v–H dependence, suggest that decrease of a_H may also contribute the observed reduction of J_{th}.

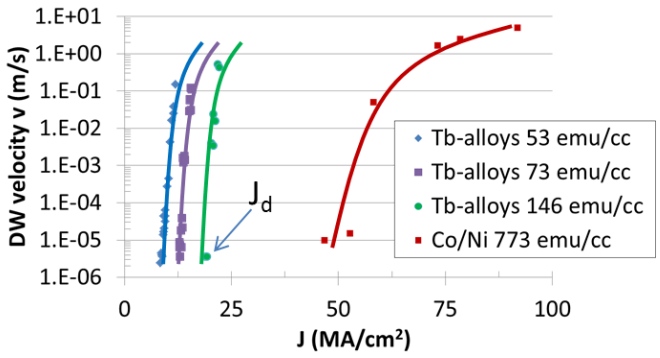

Fig.1: DW velocity vs. applied current J for Tb-alloys and Co/Ni multilayers wires (trend lines to guide the eye only).

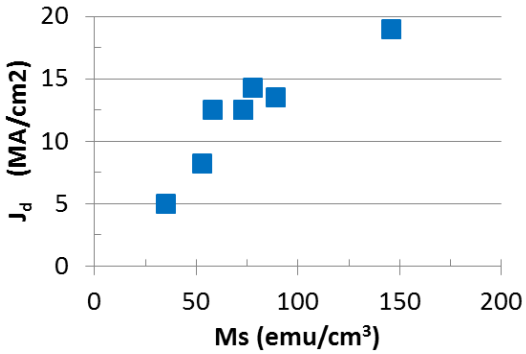

Fig.2: Onset current J_d obtained from v-J characteristics vs. Ms in Tb alloys.

Reference

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