Field-driven domain wall motion under a bias current in Pt/[CoSiB/Pt]$_N$ nanowires

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Materials with perpendicular magnetic anisotropy (PMA) accelerates the developments of spintronics devices due to their low threshold current density, simple domain wall (DW) structure, and high spin-transfer-torque (STT) efficiency, compared with in-plane magnetic anisotropy (IMA) materials. They can be used as one of magnetic components in magnetic memory and logic devices by manipulating the magnetic domain wall (DW) motion. Thus, it is important to understand the DW dynamics in PMA materials.

We investigated the DW motion in two extreme regimes of DW flow and creep motions for the amorphous PMA multilayer with heavy metals, Ta/Pt/[CoSiB/Pt]N nanowire structure, for different N and w [1]. The field-driven DW velocity in the flow regime was found to increase with N, which is ascribed to the enhancement of DW anisotropy energy with N. The DW motion under a constant bias current reveals that the DW motion prefers the current flow direction in thinner layer whereas the DW motion prefers the electron flow direction in thicker layer, implying that the SHE gradually decreases with increasing the layer thickness while the STT is constant. We also found that the relative strength of two torques is different depending on the dynamic regime of DW

Reference

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