Real time detection of magnetic domain wall motion using novel writing method

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A controlled creation, propagation, and detection of magnetic domain wall (DW) is the core process of the DW-motion-based racetrack memory[1]. Several technical issues on the device performance of racetrack memory have been raised during last decade, and many parts of the technical issues have been successfully resolved owing to the in-depth understanding of the mechanisms involved. However, there still remain several urgent issues, e.g., the reduction of the power consumption in the writing process and the confirmation of real time multiple DWs motion.

Here, we provide two novel domain writing schemes that consumes power at least an order of magnitude smaller than that of the conventional writing technique. In the first scheme, we use current-induced DW propagation to create an arbitrary domain instead of current-induced local Oersted field[2]. The key advantage of this scheme is that the current required for propagating a domain is much smaller than that for nucleating a domain. The other scheme relies on the deterministic switching based on the spin Hall effect and Dzyaloshinskii-Moriya interaction (DMI). In this scheme, the role of writing current is to provide an in-plane longitudinal field to trigger the deterministic switching and therefore, the required power can be reduced.

By employing the proposed scheme, we then demonstrate the real time detection of current-driven multiple magnetic DWs motion, which directly shows the operation of magnetic domain wall shift register[3].

References

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