Chirality sensitive magnetic field pulse driven domain wall motion with perpendicular magnetic anisotropy

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Recently, broken inversion symmetry has a great attention for future spintronic memory and logic devices since an inversion symmetry breaking system can lift the chiral degeneracy such as spin spirals and skyrmions through the Dzyaloshinskii-Moriya interaction (DMI). The DMI stabilizes chiral Neel type domain walls (DWs) whose spin configuration is significantly effective for current-induced DW motion. However, there is a lack of technique to distinguish the spin configurations of DWs such as Neel wall (NW) or Bloch wall (BW).

We here investigate the in-plane magnetic field pulse driven Bloch and Neel type DW dynamics with a strong perpendicular anisotropy (PMA). Since the precession torque to the NW and BW due to an in-plane magnetic field exerts to rotate the DW in one direction, this torque leads to the DW displacement. The direction of the DW displacement only depends on the chiralities of NW or BW and the magnetic field. According to this method, we can directly distinguish NW and BW by applying in-plane field pulses since a NW or BW only reacts the in-plane field along the y- or x- direction.

As a new approach to manipulate DW with PMA, the dynamics in-plane field pulse driven DW motion can open the high velocities and large displacements of the DW motion. Finally, synchronous multiple NW motions affected by the DMI can be observed, which can open new ways for future non-volatile memory and logic devices.