구두발표 II-2

Vortex-core reversals and its associated spin-wave emission in geometrically confined magnetic thin films

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The spiral structure can be easily found in nature in different systems ranging from nm to extremely large universe scales, such that quantized magnetic flux lines in superconductors, through water whirlpools and atmospheric tornadoes to spiral galaxies. In magnetic media, vortices, which are characterized by in-plane spiral orientations of local magnetizations and a core region of a few nm with a perpendicular orientation, have also been found in different environmental microstructures such as in a segment of cross-tie walls and near or at domain boundaries between differently orientated domains, and as a nontrivial unique structure in geometrically confined submicron-size thin-film elements. For examples, in our successive previous works we found many interesting magnetic features and novel phenomena associated with the magnetic vortices: experimentally observed array of vortices and antivortices and their interacting signature at a frozen state of demagnetized Fe thin films [1], attractive interactions of vortices and antivortices [2], spin-wave radiation by the annihilation of their pairs obtained from micromagnetic simulations [3][4]. In the following research, we have, for the first time, found a new phenomenon (mechanism) of vortex-core reversals (core-polarization switching) followed by spin-wave emission induced by in-plane oscillatory a.c. magnetic fields, which are driven by the creation, propagation, and annihilation of a vortex-antivortex pair. The vortex-core reversal is surprisingly a rapid process (sub-nanoseconds) and can be reached in relatively low in-plane fields of about 100 Oe. The model study on the dynamics of magnetic vortices, especially on the core motion and switching can provide a new insight as well as additional detailed information into the spin dynamics related to the unique structure of magnetic vortices, leading to their technological applications in many areas including magnetic data storage, processing and strong spin-wave generation.

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References

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