Phase field study on the magnetic vortices in ferromagnetic nano-platelets

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The effect of external strain on the evolution of magnetic multi-vortices in the nanoscale ferromagnetic platelets is investigated by a phase field model that explicitly includes the coupling between the magnetization and deformation. Phase field simulations show that a compressive strain makes the magnetic vortex-antivortex pair stable in the rectangular ferromagnetic platelets, which is unstable in the absence of external magnetic field and strain. The magnetic clockwise (CW) and counterclockwise (CCW) vortices pair disappears in the ferromagnetic platelets under an external magnetic field through the annihilation of vortex and antivortex or expulsion when the external strain is absent. In the presence of a tensile strain, the expulsion of CW and CCW vortices is suppressed in the ferromagnetic platelets. However, the external strain has less effect on the annihilation of CW and CCW vortices. For the ferromagnetic platelets with triple vortices, both the tensile strain and magnetic field induce the annihilation and expulsion of vortices. The strain effect on the evolution of magnetic vortex suggests a new way to control the magnetic vortex by strain engineering.

Keywords: Strain engineering, Magnetic vortex, Ferromagnetic materials, Phase field model, Magneto-elastic coupling