Manipulating topological magnetic structures by in-situ Lorentz microscopy

Dongsheng Song[1]
[1]Institutes of Physical Science and Information Technology, Anhui University, Hefei 230601, China, Hefei, China

Topological magnetic structures, i.e., skyrmions, have been considered as promising carriers in future magnetic storages or logical devices since their discovery in chiral magnets from 2009, owing to their nanometer-sized dimension, high stability and low critical current density of manipulation. The topologically protected spin textures are fundamental to these excellent performance metrics over the conventional magnetic domain walls or nanoparticles. Here, we have utilized the state-of-the-art magnetic imagining techniques, i.e., Lorentz microscopy and off-axis electron holography, to visualize the magnetization or emergent field of topological magnetic objects, in order to clarify the underlying mechanism of stability and evolution. Moreover, in-situ electrical Lorentz microscopy is employed to investigate the current-driven dynamics of skyrmions in nanostructures under the nanosecond current pulses. The skyrmion velocity and skyrmion Hall angle are measured with respect to the current density. Our results prove the possibility of coding the skyrmions in prototypical devices and have immediate significance towards the skyrmion-based memory or logic devices.

Keywords:

Lorentz miscoscopy, electron holography, skyrmion

Reference:

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