Skyrmionics: A paradigm shift in future electronics

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Topological swirling spin textures, magnetic skyrmions, have been intensively studied in spintronics as a prospective information carrier due to distinct topological features. Therefore, stabilization of magnetic skyrmions is the key technology for realizing skyrmion-based spintronic devices. However, to date, skyrmions have only been stabilized in extremely narrow ranges of material parameters. For example, more than 10 repeated numbers of multilayers are required to induce a large dipole field, or the thickness control within 0.1 nm is essential for achieving a particular magnetic anisotropy. The other key issue is to intentionally create a magnetic skyrmion. Therefore, experimental demonstrations of skyrmion creation have been achieved using diverse methods, including a pulsed local magnetic field or by a spin-orbit torque (SOT)-based perturbation. However, most of them utilized a randomly created defect site as a source of skyrmion creation, which disturbs the skyrmion motion after the creation. The above mentioned limitations in skyrmion creation are the key challenges in skyrmion research. We present a fine tuning of material parameters for stabilizing magnetic skyrmions and also provide a defect-free skyrmion creation in general PMA films using external magnetic field.