Current induced skyrmion dynamics observed by transmission x-ray microscopy

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Current induced chiral magnetic skyrmion motion was studied using x-ray magnetic circular dichroism based time-resolved transmission x-ray microscopy. Real-time skyrmion dynamics was measured while nanosecond current pulses were applied. In ferromagnetic Pt/CoFeB/MgO multilayers, we first show that skyrmions can be generated by a bipolar current pulse. The so made skyrmions could be moved along a magnetic strip at velocities up to ~10m/s with current pulses of amplitude ~$1.5\times10A/m^2$. It is also found that distinct dynamic behavior of magnetic skyrmions, such as a breathing-like motion or a translational motion, appear and can be reliably tuned depending on the magnitude of the current pulse. We also show the first ever experimental observation of antiferromagnetically coupled skyrmions stabilized in ferrimagnetic GdFeCo multilayers. Similar to ferromagnetic skyrmions, the ferrimagnetic skyrmions could also be translated along a magnetic strip with electrical current. More importantly, the ferrimagnetic skyrmions show a much smaller skyrmion Hall effect, which indicates that ferrimagnetic skyrmions might be better suited for skyrmion based device applications.