# Diffusive motion of skyrmions enhanced by perpendicular alternating magnetic field

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Magnetic skyrmion motion has attracted attention in spintronics because of its rich physical phenomena and possibilities of applications. Moreover, diffusive motion of skyrmions has a potential for being an experimental model of information thermodynamics and Boltzmann machines [1-3]. To enhance the calculation speed, increase in a skyrmion diffusion constant is significant. One of the ways for enhancement of diffusion constant is applying magnetic field noise. While a skyrmion motion under external alternating magnetic field has been investigated [4], effect on a diffusion constant has not been clarified. This study demonstrates the enhancement of diffusion constants of magnetic skyrmion under alternating magnetic field used as a role of external magnetic field noise.

The skyrmion film composed of Ta(5)|Co-Fe-B(1.3)|Ta(0.2)|MgO(1.5)|$SiO_2$(3) was deposited on a thermally oxidized silicon substrate by a magnetron sputtering. The perpendicular magnetic field of 0.4 mT was applied by a permanent magnet, and the perpendicular alternating magnetic field at 800 Hz was applied by an air core coil. The skyrmion film was observed by a magneto-optical Kerr effect microscope with the frame rate of 60 fps. Figure 1 shows the skyrmion trajectory at the alternating magnetic field of 28 μT. From the trajectories, we characterized the diffusion constant under the various alternating magnetic fields (Figure 2). We found that the diffusion constant exponentially increases by the magnitude of alternating magnetic field. This result is attributed to a depinning of magnetic skyrmions by the alternating magnetic field. This research and development work was supported by ULVAC, Inc. and the Ministry of Internal Affairs and Communications.

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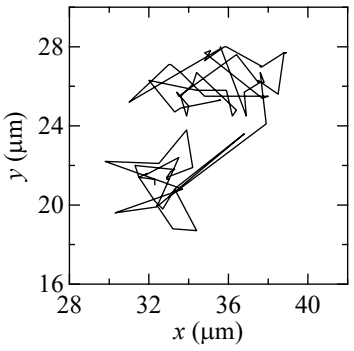


Figure 1 Trajectory of magnetic skyrmion under the alternating magnetic field of 28 μT.

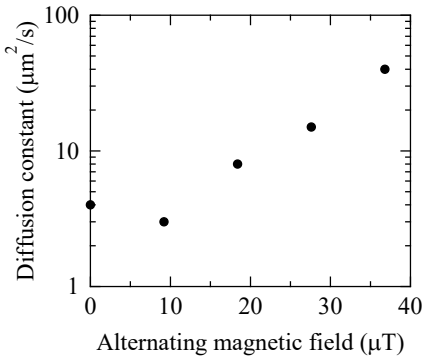


Figure 2 Alternating magnetic field dependence of diffusion constant.