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Spin wave dynamics and magnetization switching in exchange-coupled bilayers

TAKESHI SEKI, Institute for Materials Research, Tohoku University

Magnetic moments under the application of electric current or rf magnetic field show uniform or non-uniform dynamical motions, which are keys to develop novel spintronic devices such as nanometer-sized auto-oscillators and logic circuits. Spin waves are representative of spatially non-uniform magnetization dynamics. We demonstrated that spin waves could be utilized also to reduce the switching field in exchange-coupled bilayers consisting of hard magnetic L10-FePt and soft magnetic Permalloy (Py; Ni81Fe19). The switching field of L10-FePt was drastically reduced when the spin waves were excited. This "spin wave-assisted magnetization switching" is a route to balance competing goals for high coercive field, which is essential to maintain a good thermal stability of magnetization in a nanometer region, and low switching field, leading to the device operation with low power consumption. Those are important to realize high-performance spintronic and magnetic storage devices.In this talk, the concept and mechanism of spin wave-assisted magnetization switching are introduced. By comparing the experiments and the numerical simulation, it is found that perpendicular standing spin wave modes are mainly excited in Py of the exchange-coupled bilayers and those spin waves affect the dynamics of L10-FePt through the exchange coupling mechanism at the interface. The significant reduction of switching field is achieved by exciting the spin waves with large oscillation amplitude. In addition, the spin wave-assisted magnetization switching shows the characteristic magnetic field angular dependence, which is totally different from that of uniform magnetization dynamics. We also show the spin wave dynamics in perpendicularly magnetized exchange-coupled bilayers.