Investigation of magnetization dynamics in an ultrathin cobalt by the spin-torque ferromagnetic resonance

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An ultrathin metallic film has been attracting many researchers because of its different physical properties from those of the bulk state. Especially, gate-voltage control of magnetism in an ultrathin ferromagnetic film has been studied to apply for spintronics devices harnessing magnetization switching, magnon transportation, and photon-magnon coupling [1]. We realized excitation of ferromagnetic resonance (FMR) by a weak external magnetic field and significant reduction of magnetization damping in 1 nm-thick ultrathin Co film by inserting Ta buffer layer [2], which expanded a possibility of tunable magnetization dynamics that can appear in an ultrathin magnetic film. In addition, it is expected that spin-torque ferromagnetic resonance (ST-FMR), which has been the platform for research of magnetization dynamics [3], can be observed in an ultrathin Co film on a Ta buffer layer. To explore the potential of magnetization dynamics in an ultrathin ferromagnetic film, we investigated ST-FMR in an ultrathin Co/Ta bilayer.

We prepared a 1.5 nm-thick Co on a Ta buffer layer by using RF magnetron sputtering and fabricated Au (100 nm) / Ti (3 nm) electrodes by using electron beam deposition as shown in Fig. 1. A ST-FMR measurement was carried out by injecting a rf current in 10 dBm and applying a magnetic field along 45° to the current-flowing direction. Figure 2 represents frequency dependence (5-11GHz) of the ST-FMR signals, where the FMR with small magnetic damping was successfully excited in the ultrathin Co film. The Gilbert damping constant was estimated to be 0.036, which was sufficiently small as spintronics devices. In the presentation, we will discuss magnetization dynamics of the ultrathin Co layer through ST-FMR measurements and explore the possibilities of ultrathin Co film as candidate of magnetization dynamics.

[1] D. Chiba *et al*., J. Appl. Phys. **46,** 213001 (2013).[2] S. Yoshii *et al*., Sci. Rep. **10**, 15764 (2020).
[3] L. Liu *et al.,* Phys. Rev. Lett. **106**, 036601 (2011).

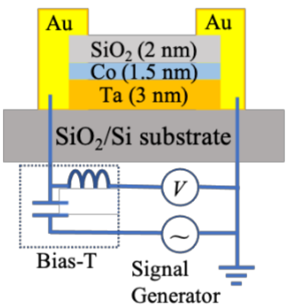

Fig. 1 Device structure and experimental setup.

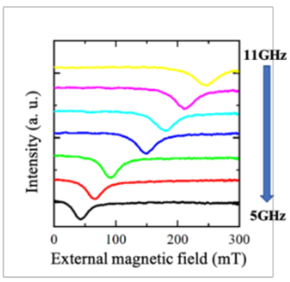

Fig. 2 Frequency dependence of the ST-FMR signals.