Voltage dependence of spectra in elliptical shaped STOs with different aspect ratio

AIST ○Bochong Wang, Hitoshi Kubota, Kay Yakushiji, Shingo Tamaru,
Akio Fukushima, Shinji Yuasa
E-mail: b.wang@aist.go.jp

Spin torque oscillators (STOs) attract much interest because of their potential applications to nano-sized microwave devices, for which large emission power and high Q factor are necessary. We reported circular shaped STOs (ϕ~300 nm) exhibiting an emission power of 2.5 μW.[1] However, it showed a low Q factor (typically several hundreds). To enhance the Q factor, we need to understand deeply the evolution of the dynamics from thermally induced magnoise at a low bias voltage to large angle out-of-plane precession at a high voltage. At a low voltage, it is reported that the magnoise spectrum of a circular-shaped FeB free layer is well explained by spin wave eigenmodes.[2] In this study, we investigated the evolution of spectra with bias voltage in STOs having various lateral shape.

We prepared multilayers with a stacking structure of CoFe/Ru/CoFeB/CoFe/MgO/FeB/MgO, which was patterned into elliptical shapes with an aspect ratio (AR) ranging from 1 to 5. The area was kept constant (150×150×π nm^2). Fig. 1(a) shows the STO spectra measured at a low voltage (200 mV), which corresponds to magnoise. The spectrum of AR=1 shows widely distributed multiple peaks. At higher AR, the satellite peaks became small and one or two large peaks remained. Fig. 1 (b) shows the spectra observed at a high voltage (350 mV), where large angle precession was induced. The spectrum is narrower in higher aspect ratios. We will show the evolution of the spectra with voltage and discuss the difference of the precession dynamics between different AR samples.

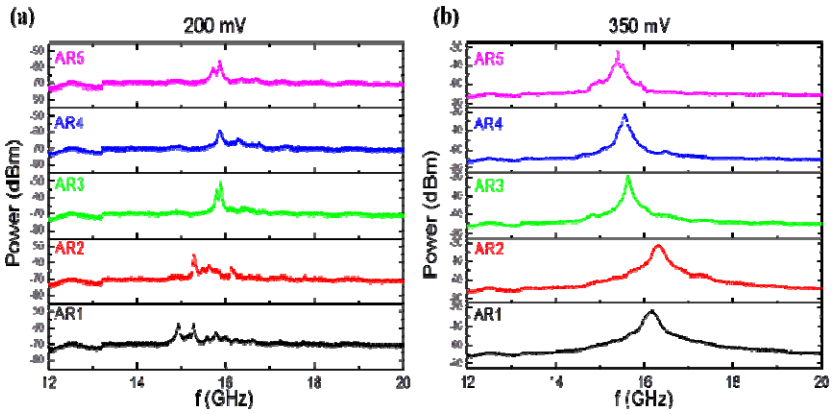

Fig. 1 The STO spectra measured at (a) 200 mV and (b) 350 mV with different AR. The constant field of 6 kOe was applied tilted 30 degree from film normal.

Reference

1. B. Wang, et al., Appl. Phys. Lett. **108**, 253502 (2016).
2. J. Cho et al., Phys. Rev. B **94**, 184411 (2016).

© 2017年 応用物理学会