EA07

Spin-torque Oscillator with Tilted Fixed Layer Magnetization

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Spin torque oscillator (STO) is an extremely compact, current tunable microwave generator, which utilizes the spin momentum transfer effect [1]. While the STO has significant advantages, such as easy on-chip integration and extremely high Q, it typically requires a large static magnetic field for operation. In this work a novel STO design, where the magnetization of the fixed layer is tilted out of the film plane, has been theoretically studied and the possibility of microwave generation in zero magnetic field has been demonstrated.

Inset of Fig. 1(a) shows our design for the tilted STO. We assume an asymmetric Slonczewski type torque incorporated into the LLG equation [2,3]. The dynamic phase diagram of frequency and effective magnetoresistance (MR) as a function of the driving current density J and tilt angle β have been shown in Fig. 1 (a) and (b), respectively. From Fig. 1(a), it can be seen that the working current windows have a non-monotonic dependence on the tilt angle, with a maximum around 21°. The effective MR is generally larger at small angles for both current polarities [Fig. 1(b)]. The critical current gradually decreases with the tilt angle as shown in inset of Fig. 1(b).

In summary, we have investigated a new type of spin torque oscillator which combines both relatively high effective MR and relatively high frequency without applied field.

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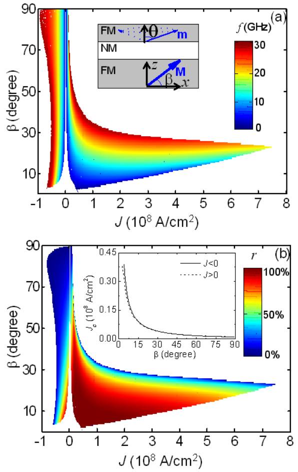

Fig. 1. (a) Frequency and (b) effective MR versus the driven current density at different tilted angles, respectively.

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EA08

Spin-Torque Oscillator using a Planar Free Layer with Negative Anisotropy Constant

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The spin transfer torque [1] of which is described by the transfer of the angular momentum from spin-polarized current to local magnetization acts like an antidamping torque on the magnetization, so that the local magnetization can sustain its precessional motion without external field. Using the steady-state precession of the magnetization, there are some examples of practical application for a spintronics device. One will be the wide-band tunable radio frequency (RF) oscillator for the application of telecommunication or logic devices [2]. Recently, it is reported that the high-frequency oscillation will be achieved by using the perpendicular polarizer as a pinned layer [3].The other is the high frequency field generation for high density hard disk drive (HDD), and J. Zhu et al proposed the microwave assisted recording media [4]. In this work, we propose a novel structure to obtain the more high frequency microwave (model "A") and field (model "B"). Then, we conduct micromagnetic simulation to verify our model. By introducing an additional free layer with negative anisotropy constant (NKL) on the conventional spin valve structures, we can achieve very high frequency up to 50 GHz (Fig. 1). For the negative anisotropy materials, CoFe, a-FeC, NiAs-typed MnSb, hcp CoIr, that are composed by the double h.c.p structure are experimentally suggested [5]. Although the current density is over the critical switching current density (J_{SW}), it is possible to align the magnetization of the NKL along the in-plane direction, so that the high frequency oscillations are obtained for the wide range of the current density. In the presentation, details of the mechanism and spin dynamic will be presented.

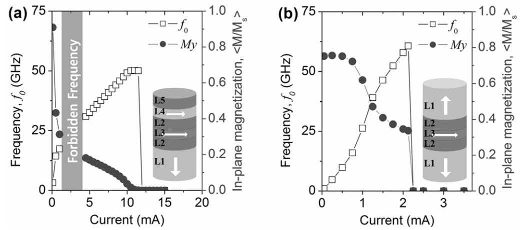

Fig. 1. Precession frequency and normalized magnetization of L3 as a function of current density. Inset shows geometry of modeling system. (a) and (b) correspond to the model "A" and "B", respectively. The notations of L1 ~ L5 indicate perpendicular polarizer, free layer with negative anisotropy constant, free layer, analyzer, and SAF layer, respectively.

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