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利用形態 : 機器利用
利用課題名（日本語） : BiSb トポロジカル絶縁体を用いたスピン軌道トルク磁気抵抗メモリ
Program Title (English) : Study of SOT-MRAM using BiSb topological insulator
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1. 概要（Summary）

Topological insulators (TIs) are quantum materials with insulating bulk and topological surface states. They are attractive spin current sources for spin-orbit-torque (SOT) MRAM application thanks to their very large spin Hall angle. Among TIs, BiSb attracts great interest as BiSb shows both high electrical conductivity and giant spin Hall angle in epitaxial BiSb(012) thin films (θ_{SH} ~ 52, σ ~ 2.5×10^5) [1]. However, in SOT-MRAM using BiSb, it is important to suppress Sb diffusion toward the magnetic free layer (FM) that may destroy its magnetic properties and reducing the spin injection efficiency. In this work, to resolve such problems, we introduce a NiO interface layer at the BiSb/FM interface, and evaluated SOT by the second harmonic Hall measurements.

2. 実験（Experimental）

【利用した主な装置】

触診式段差計

【実験方法】

We prepared sapphire substrate/BiSb(10 nm)/NiO (0.5,1.0,1.5, 2.0, 2.5, 3.0 nm)/Co (1 nm)/Pt(1 nm) multilayers by sputtering deposition, and evaluated SOT by the second harmonic Hall measurements.

3. 結果と考察（Results and Discussion）

Figure 1 shows the effective spin Hall angle θ_{SH}^{eff} of BiSb as a function of the NiO layer thickness t_{NiO}. θ_{SH}^{eff} is moderate for t_{NiO} = 0 – 0.5 nm, but rapidly increases at t_{NiO} = 1.0 – 3 nm, demonstrating that NiO can enhance the spin injection efficiency from BiSb to Co. Furthermore, we observe a rapid decrease of the effective anisotropy magnetic field H_k of the Co layer at increasing t_{NiO}, indicating the existence of perpendicular magnetic anisotropy at the NiO/Co interface. The Co layer become perpendicularly magnetized at $t_{NiO} \geq 2$ nm, as shown in Figure 2. Our results show that BiSb/NiO is very attractive for a highly efficient and practical spin current source in SOT-MRAM.

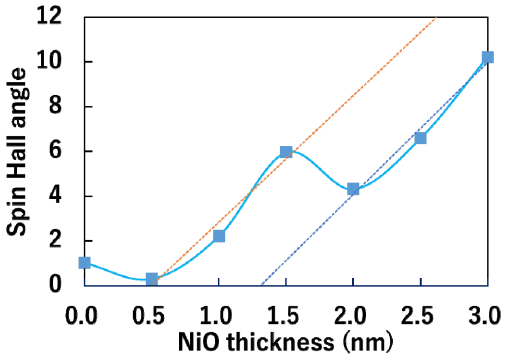

Fig. 1. Relation between NiO thickness and spin Hall angle.

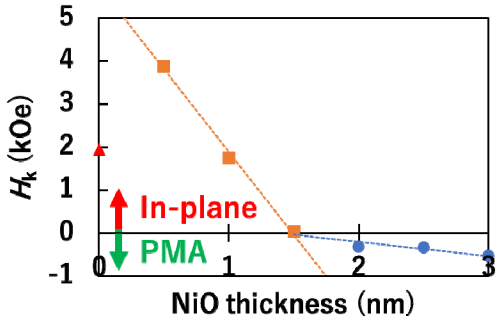

Fig. 2. Relation between NiO thickness and anisotropy magnetic field.

4. その他・特記事項（Others）

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5. 論文・学会発表（Publication/Presentation）

1. Julian Sasaki、Shigeki Takahashi、Yoshiyuki Hirayama、Pham Nam Hai, “Highly efficient spin current source using BiSb topological insulator / NiO bilayers”, 82th JSAP Autumn meeting, Sept. 2021.

6. 関連特許（Patent）

NA