Spin-to-charge conversion mechanism in TbCo/Pt/YIG due to spin Seebeck effect

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In this study, we demonstrate the conventional inverse spin Hall effect (ISHE) and magnetization-dependent ISHE (MD-ISHE) in TbCo/Pt/$Y_3Fe_5O_{12}$ devices using the spin Seebeck effect [1,2]. It was found that a thermally injected spin current is converted into two charge currents: (1) dependent on the magnetization direction of TbCo (MD-ISHE) and (2) independent on the magnetization direction of TbCo (ISHE). Here, we investigate the effect of Pt and TbCo thicknesses on the ISHE and MD-ISHE. We found that the MD-ISHE is originated by the TbCo/Pt interface, whereas the conventional ISHE is dominated by the bulk Pt and TbCo. Meanwhile, the spin diffusion length of TbCo is estimated to be ~5.5 nm. Our findings demonstrate that perpendicularly magnetized TbCo supplies additional symmetry to the ISHE and provides advantages in terms of tailoring the spin-current polarization.

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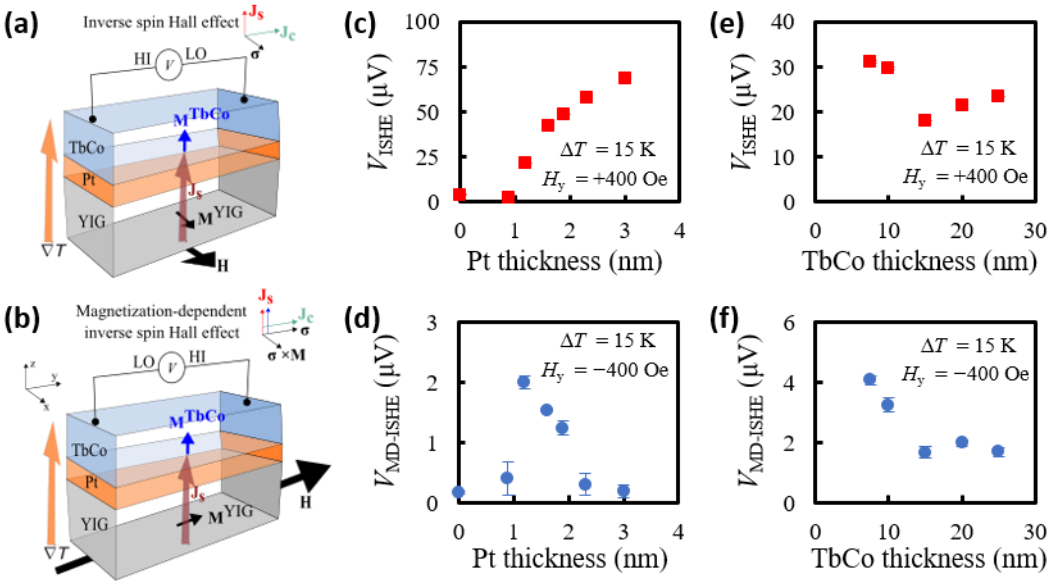

FIG 1. Experimental condition for the (a) ISHE and (b) MD-ISHE. Pt thickness dependence (fixed t_{TbCo} = 20 nm) of (c) V_{ISHE} and (d) $V_{MD-ISHE}$. TbCo thickness (fixed t_{Pt} = 1.2 nm) dependence of (c) V_{ISHE} and (d) $V_{MD-ISHE}$.

[1] A. Yagmur, S. Sumi, H. Awano, and K. Tanabe, Large Inverse Spin Hall Effect in CoTb Alloys due to Spin Seebeck Effect, Phys. Rev. Appl. **14**, 064025 (2020).

[2] A. Yagmur, S. Sumi, H. Awano, and K. Tanabe, Magnetization-dependent inverse spin Hall effect in compensated ferrimagnet TbCo alloys, Phys. Rev. B **103**, 214408 (2021).