Effect of nonmagnetic layer on perpendicular magnetic anisotropy of X(X=Ta, Hf, and Yb)/CoFeB/Mg/MgO structures

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1. Introduction

Ta/CoFeB/MgO structures are known to have a decent perpendicular magnetic anisotropy (PMA), and magnetic tunnel junctions (MTJs) based on these structures yield a high tunnel magnetoresistance (TMR) of over 120% [1]. It has been recently reported that the PMA can be enhanced by replacing Ta by Hf in the above structure [2]. It is expected that the PMA can be further improved by inserting an Mg layer between CoFeB and MgO layers [3]. Here we studied the perpendicular magnetic anisotropy PMA of X (X=Ta, Hf, and Yb)/ $Co_4Fe_4B_2$/ Mg/ MgO/ Ta structures.

2. Experiment Method

We deposited the samples on the oxidized Si(100) substrates using DC and RF magnetron sputtering, and annealed the samples after deposition. The magnetic properties of the samples were characterized by vibrating sample magnetometer (VSM).

3. Results and Discussion

The PMA in X (X=Ta, Hf, and Yb)/ $Co_4Fe_4B_2$/ Mg/ MgO is significantly affected by the annealing temperature, and the annealing temperatures showing the maximum PMA are dependent on the nonmagnetic layer, Ta, Hf, and Yb. Especially, the Yb/ $Co_4Fe_4B_2$/ Mg/ MgO structure shows PMA with a relatively lower annealing temperature.

4. Conclusion

In summary, we show that the PMA in X (X=Ta, Hf, and Yb)/ $Co_4Fe_4B_2$/ Mg/ MgO depends not only on the thickness of CoFeB but also on the nonmagnetic buffer layer. The structures studied in this paper can be used for perpendicular magnetic tunnel junctions having a free-layer of X (X= Ta, Hf, and Yb)/CoFeB/Mg/MgO and other spintronics devices.

5. Reference

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