Composite underlayer/CoFeB/MgO structures with interfacial perpendicular magnetic anisotropy

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Magnetic tunnel junctions (MTJs) with perpendicular magnetic anisotropy (PMA) are used to scale down the cell size of magnetoresistive random access memories (MRAMs), since magnetic layers with PMA can provide large enough thermal stability to avoid unwanted switching of nano-magnetic elements. The Ta/CoFeB/MgO structure is known to have a decent interfacial PMA, and perpendicular-MTJs based on these structures provide a high Tunnel magneto-resistance (TMR) of over 120% [1]. It has been recently reported that the PMA in Ta/ CoFeB/ MgO structure can be improved by replacing Ta by Hf [2]. Here we have studied the effect of composite underlayers on the PMA in underlayer/CoFeB/Mg/MgO structures.

We have deposited samples using both DC and RF magnetron sputtering on the oxidized Si substrates, and annealed the samples at various temperatures. The magnetic properties were characterized by vibrating sample magnetometer (VSM), and the PMA and interface anisotropy energy are obtained using *M-H* curves.

The magnetic properties of composite underlayer/CoFeB/Mg/MgO structures depend significantly on the underlayer and annealing temperature. We found that the diffusion of boron as well as the underlayer material mainly contributes to the effective magnetic thickness, saturation magnetization, and interface PMA of underlayer/CoFeB/Mg/MgO structures. By selecting a proper combination of underlayer materials, it is possible to obtain a high interfacial PMA with annealing at a relatively high-temperature.

References

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