

Compositional change of MgO barrier and interface in CoFeB/MgO/CoFeB tunnel junction after annealing

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Recent experiments have demonstrated high TMR ratios in MTJs with the MgO barrier [1, 2]. The CoFeB/MgO/CoFeB junctions showed better properties than the CoFe/MgO/CoFe junctions because the MgO layer had a good crystalline structure with (001) texture and smooth and sharp interface between CoFeB/MgO [3]. The amorphous CoFeB with 20 at%B starts the crystallization at 340°C [4] and this crystallization of the CoFeB helps obtaining the high TMR ratio. In this work, the compositional changes in the MgO barrier and at the interface of CoFeB/MgO/CoFeB after the CoFeB crystallization were studied in annealed MTJs. XPS depth profiles were utilized. TEM analyses showed that the MgO barrier had (100) texture on CoFeB in the junctions and CoFeB was crystallized in the annealed junctions. B in the bottom CoFeB layer diffused into the MgO barrier and B-oxide was formed at the interface of CoFeB/MgO/CoFeB after the CoFeB crystallization. The increase of polarization at the bottom electrode sides is the reason for the higher TMR ratio in CoFeB/MgO/CoFeB junctions due to cleaner interface and/or the reduction of Fe-oxide at the interface. Another reason may be the crystallization of the CoFeB electrodes and formation of physically sharp interface.

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