Exchange Bias Effected by Ion Beam Etching of FeMn Surface in Ta/NiFe/FeMn

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The exchange bias field of Ta(5)/NiFe(10)/FeMn(20) (nm) multilayer films are investigated as a function of FeMn thickness, where the FeMn layer is etched by Ar ion beam. Etching parameters related with etch rate and surface state such as beam tilt angle and beam acceleration voltage are investigated whether the low energy ion beam etching bring about structural damages in the FeMn alloy film. It was found that the surface roughness decreases by ion beam etching without the introduction significant structural damage in the FeMn layer. Beam acceleration voltage only makes slight difference in the grain size after etching. Exchange bias improvement is observed even in the initiation of FeMn surface etching. This improvement could be related with the removal of surface oxide layer or irregularities. The exchange field jumps when the FeMn thickness changes from 12 nm to 10 nm, and reachs maximum value at FeMn thickness of 7 nm. The exchange bias begins to decrease with further etching and drops rapidly at the 5nm FeMn thickness.