Coercivity Variations at the Top and Bottom NiFe layers in NiFe/FeMn/NiFe Trilayers

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NiFe/FeMn/NiFe trilayers form an integral part of spin valve multilayer structures with FeMn antiferromagnet, when NiFe is used as a seed layer to facilitate growth of (111) γ-FeMn antiferromagnetic phase [1]. The bottom NiFe is the seed layer and the top NiFe forms the pinned layer in the spin valve structure. This trilayer structure consisting of two NiFe/FeMn interfaces shows two independent hysteresis loops with different exchange bias and is an interesting nanostructure for investigation of the development of exchange bias and coercivity in the NiFe/FeMn system. A systematic investigation of the coercivity at the two interfaces have not yet been carried out. In this study we have investigated the development of coercivity at the bottom and top NiFe layers in this trilayer system, in multilayers with composition Si/SiO_2/Ta(5)/NiFe(t)/FeMn(10)/NiFe (5)/Ta(5) and Si/SiO_2/Ta(5)/NiFe(5)/ FeMn(10)/NiFe (t)/Ta(5) where t = 2,3,4,5,6,8,10, 15 and 20 nm thickness, in which the thickness of bottom and top NiFe are varied respectively in the trilayer. We find that the top NiFe which forms the pinned layer shows greater coercivity in the case of both the top and bottom NiFe thickness variation. After initial low values for 2 nm NiFe thickness, the coercivity increase to 25 to 30 Oe for 3 to 5 nm NiFe thickness, remains more than 15 Oe up to 10 nm thickness of NiFe and then falls to less than 10 Oe for larger NiFe thickness. The bottom NiFe layer shows relatively low maximum values of coercivity of 20 Oe at 3- 4 nm thickness of NiFe which falls to less than 10 Oe at and above 8 nm thickness of NiFe. For NiFe thickness of 2 nm in the case of top NiFe thickness variation, and above 8 nm thickness for bottom NiFe thickness variation, unusually large coercivities are observed. Coercivity variations are discussed on the basis of change in populations of AFM (antiferromagnet) domains with differing anisotropy energy at the two NiFe/FeMn interfaces [2].

References

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