Magnetoresistance of spin-filter specular spin valves

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We study on a spin-filter specular spin valve (SFSSV) with nano-oxide specular layers with structure Ta3/NiFe2/IrMn7/CoFe1/(NOL1)/CoFe2/Cu1.8/CoFe(t_F)/Cu(t_{SF})/(NOL2)/Ta3.5 (in nm) deposited by dc magnetron sputtering on thermally oxidized Si (100) substrates. The SFSSV is demonstrated to maintain MR ratio higher than 11% even when the CoFe free layer is reduced to 1.0 nm. An optimized MR ratio of 11.9% was obtained (refer to Fig. 1) when t_F was about 1.5 nm and t_{SF} about 1.0 nm, and was a result of the balance between the increase in the electron mean free path difference and current shunting through the conducting layer. It was also found that the Cu enhancing layer can improve the magnetic properties of the CoFe free layer due to the low atomic intermixing Co and Cu, and prevent oxidation of the ultrathin CoFe free layer. The CoFe free layer of 1~3 nm exhibited coercivity of ~3 Oe after annealing in a static magnetic field. This kind of SFSSV with a very thin soft CoFe free layer is attractive for ultra high density recording head applications.

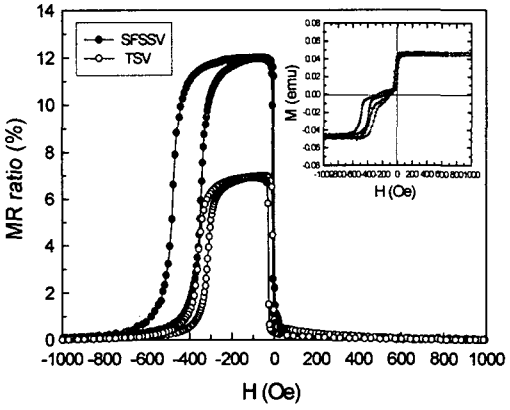

Fig. 1. MR curves for spin-filter specular spin valve Si/SiO_2/Ta3/NiFe2/IrMn7/CoFe1/(NOL1)/CoFe2/Cu 1.8/CoFe1.5/Cu1.0/(NOL2)/Ta3.5 (in nm) and traditional spin valve Ta3/NiFe2/IrMn7/CoFe3/Cu 1.8/CoFe4/Ta3.5. Inset represent magnetization curves.

References

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