

The Reduction of Attenuation Lengths in Magnetic Tunneling Transistors with FeCo-base

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One of the factors influencing the magneto-transport-properties of the magnetic tunnel transistors (MTTs) structures as (Si(100)/CoFe/AlO_x/CoFe/FeMn/Cu/Ta with differing base thickness (W) is the mean free path asymmetry of majority (λ) and minority (λ) electrons, λ/λ . And, the MC ratio is sensitive to and depends largely on λ/λ [1]. In this work, we have explained in detail the role of λ/λ in MTTs in both simulation and experimental results. For the simulation results, the MC ratio was plotted as a function of λ/λ at various W/λ values when spin polarization in the emitter (PE) is 28% (assuming that leakage current is negligible). The MC ratio increases either increasing λ/λ or decreasing W/λ .

Also, the original reducing of λ/λ was clarified by using X-ray Photoelectron Spectroscopy (XPS) profile analysis of the elements existing in the interface between Si and CoFe-base (Co, Fe, Al, Si, O). Moreover, XPS profile analysis showed that the CoFe-base has an (Co₂Si, Fe) intermediate region adjacent to Si(100) and this intermediate region may have an influence on reducing λ/λ and the MC ratio. Therefore, in reducing the leakage current, operation of the Si-based MTT structure with high MC ratio will be realized at room temperature and it is a good candidate of read head device in high density recording devices.

[1] D. J. Monsma, *et al.*, Science 281 (1998) 407