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Annealing Temperature Dependence of Noise in MgO Magnetic Tunnel Junctions

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Noise measurements performed in MgO based tunnel junctions at different annealing temperatures were investigated. The MTJ's studied in this work were deposited on thermally oxidized Si wafers using multitarget high-vacuum magnetron sputtering system. The MTJ layer structure is Ta(10nm)/ NiFe(3)/ IrMn(10)/ ($Co_{75}Fe_{25}$)(2) / Ru(0.85) / ($(Co_{50}Fe_{50})_{80}B_{20}$(5) / MgO(2.5) / $(Co_{50}Fe_{50})_{80}B_{20}$ (3) / Ta(5)/Ru(5). Junctions with normalized resistance in the range of 10^5 -10^6 Ωμm^2 and with increasing MR ratio with annealing temperatures to about 180% were investigated. The noise measurements in the frequency range between 1 Hz and 1 kHz were performed in the presence of static easy axis bias field in parallel(P) and antiparallel(AP) states. At room temperature, the noise measurements were carried out in as-depo samples and at 275°C , 300°C , 350°C and 400°C accumulating annealing temperatures. The normalized noise parameter, αH increases slowly with annealing temperatures up to 325°C and beyond that temperature the noise level increases drastically to about 10^{-5} μm^2 and 10^{-7} μm^2 for magnetization in AP state and P state respectively as shown in Figure 1. Sudden increase in the noise level indicates the condition of the barrier and its interfaces that maybe due to the breaking of the atomic bonding of the junction and the diffusion of free ions such as Mn at certain annealing temperature. In another junction this behaviour occurred at higher temperature of about 400°C at which the TMR percentageis shown to reduce. Direction of current flow through the sample also affect the noise level. This observation maybe due to interfaces effect near the oxide barrier and can be use to monitor the effect of annealing temperature in the top and bottom layer of the junction.

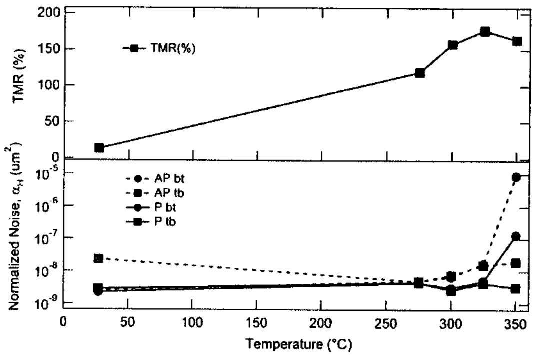

Fig. 1. TMR (%) (top) and Normalized Noise, α_H (bottom) as functions of annealing temperatures. In the graph (bottom) bt and tb referring to bottom to top and top to bottom current direction respectively.

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Influence of Buffer Layers on the Texture and Micromagnetic Properties of Co/Pt Multilayers with Perpendicular Anisotropy

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A study on the buffer layer dependence of film texture, surface roughness, and magnetization reversal process in Co/Pt multilayers is presented. Four different buffers are used: (A) 10 nm Cu, (B) 5 nm Ta/10 nm Cu, (C) 5 nm Ta/10 nm Cu/5 nm Ta, and (D) 5 nm Ta/10 nm Cu/5 nm Ta/10 nm Cu. The growth of [2 nm Pt/0.5 nm Co]$_5$/2 nm Pt on top of these buffer layers results in a large variation in film texture and surface morphology. Samples with a Cu buffer (A) exhibit a low degree of film texture and disordered polycrystalline waviness. MOKE and MFM measurements on these films reveal that the magnetization reverses by the nucleation of numerous small domains, indicating a large dispersion of activation energy barriers. Buffer layer structures where the first layer consists of Ta, on the other hand, result in well-textured Co/Pt multilayers with a more regular surface morphology. In these samples, magnetization reversal occurs by fast domain wall movement.