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Enhanced interface perpendicular magnetic anisotropy in nitrogen doped Ta underlayer with CoFeB|MgO

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Recent observation of perpendicular magnetic anisotropy (PMA) in Ta|CoFeB|MgO has drawn significant interest due to its application in magnetic random access memories. In this system, both CoFeB|MgO and Ta|CoFeB interfaces are crucial for obtaining and enhancing PMA. We investigate the PMA in Ta|CoFeB|MgO with various concentration of Nitrogen (N_2) doping in Ta underlayer and find enhanced PMA for optimally N_2 doping.

The film stacks studied are comprised of x Ta|d CoFeB|2 MgO|1 Ta (digits in nm, x and d varied suitably). A small amount of N_2 is introduced during the deposition of the Ta underlayer to study the effect of nitrogen doping of Ta on the PMA. For films with Ta and optimally N_2 doped Ta underlayers, we studied the variation of saturation magnetization (M_s) and the magnetic anisotropy (K_{eff}) as a function of effective CoFeB thickness. The effective CoFeB thickness is determined by subtracting the dead layer thickness from the nominal deposited thickness. A comparatively larger M_s for Ta underlayer stack is observed possibly due to more efficient B diffusion. We find enhanced K_{eff} for optimally N_2 doped Ta underlayer. Our analysis reveals increased interface anisotropy for optimally N_2 doped Ta underlayer stack which helps in observation of larger K_{eff}. The role of N_2 doping in enhancing PMA will be discussed.

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