Low resistance magnetic tunnel junctions with MgO wedge barrier

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We investigated dependence of tunnel magnetoresistance (TMR), resistance area product (RA), crystallographic structure, interlayer exchange coupling and switching fields in Co40Fe40B20 (amorphous) / MgO (001) (polycrystalline) / Co40Fe40B20 (amorphous) exchange biased spin valve on Ar pressure during MgO sputtering. Therefore we deposited MgO using a wedge technology, allowing to scan the whole range of thickness in one deposition run. The stack of magnetic tunnel junction films were deposited onto thermally oxidized Si wafer using magnetron sputtering system (Singulus TIMARIS PVD tool) with base pressure better than 5×10⁻⁹ Torr. The current in plane tunneling (CIPT) technique [1], using CAPRES set-up, was applied for TMR and RA measurements on unpatterned wafer.

Fig. 1a shows the plots of the TMR ratio at room temperature as a function of RA for different pressures of Ar. For pressure higher than 3.8 mTorr TMR no more increased. This optimal pressure resulted in high textured growth of MgO barrier in (001) direction, while low Ar pressure (1 mTorr) deposition caused weaker texture of MgO layer (Fig. 1b). In consequence higher sputtering pressure allowed to obtain high TMR and low RA junctions with very good parameters for spin transfer torque experiment in nanopillars (e.g. TMR=100% and RA=1.2 Ωµm²).

![Fig. 1](image-url)

**Fig. 1** a) TMR ratio as a function of RA product for Co40Fe40B20 / MgO / Co40Fe40B20 MTJs with pressure in the range from 1 mTorr to 15 mTorr during MgO deposition b) rocking curves (ω scans) of MgO(001) for bilayers Co40Fe40B20 / MgO deposited at 1mTorr and 3.8 mTorr. FWHM of the rocking curves for samples prepared at 1mTorr and 3.8 mTorr Ar pressure equal 7.1° and 6.5°, respectively.


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