Conductance study of magnetic tunnel junctions with an ultrathin MgO barrier

A Zaleski[a], J Wrona[a], M Czapkiewicz[a], W Skowroński[a], J Kanak[a], T Stobiecki[a]

[a]AGH University of Science and Technology, Department of Electronics
al. Mickiewicza 30, 30-059 Krakow, Poland

9.7 cm

A magnetic tunnel junctions (MTJs) multilayer stack was studied, consisting of the following materials (thickness in nm): PtMn(16)/$Co_{70}Fe_{30}$(2.0)/Ru(0.9)/$Co_{40}Fe_{40}B_{20}$(2.3)/ /MgO t_{MgO}/$Co_{40}Fe_{40}B_{20}$(2.3). MgO barrier thickness (t_{MgO}) ranged from 0.6 to 1 nm, corresponding to a Resistance-Area (RA) products below 10 $\Omega\mu m^2$ and a Tunnel Magnetoresistance (TMR) ratio above 180 %. Stacks were prepared with varied Ar partial pressure (p_{Ar}) during MgO sputtering. Low p_{Ar} range was 1-3.8 mTorr, whilst high p_{Ar} was in the range 5.6-15 mTorr. For low tunnel barrier thickness (t_{MgO} <0.7 nm) the appearance of structural defects is very likely. An extension of equivalent circuit model [Oliver et al. J.Appl. Phys. 91 4348 (2002)] was applied to the current-in-plane tunneling measurements of the multilayer stack wafer in order to analyse effect of p_{Ar} and t_{MgO} on TMR and RA. Good agreement was achieved between the model and experimental results of the shunt resistance contribution to conductance as a function of t_{MgO} for various p_{Ar}. Our approach can be very useful for characterization of the unpatterned MTJ wafers. **Acknowledgments:** Project supported by SPINSWITCH MRTN-CT-2006-035327, the Polish Ministry of Science and Higher Education grants (IP 2010037970 and NN 515544538), and the Foundation for Polish Science MPD Programme cofinanced by the EU European Regional Development Fund.

13.4 cm

Subject category :

4. Spin Electronics and Magneto-Transport

Presentation mode :
poster

Corresponding author :
A.Zaleski

Address for correspondence :
al. Mickiewicza 30
30-059 Krakow, Poland
AGH University of Science and Technology

Email address :
zaleski@agh.edu.pl