

SETUP FOR MAGNETIC TUNNEL JUNCTIONS MEASUREMENTS*

W. Skowroński

*Department of Electronics, AGH University of Science and Technology,
Al. Mickiewicza 30, 30-059 Kraków, Poland*

A setup for magnetic tunnel junctions (MTJs) measurement that characterizes basic parameters of junctions, was built. The system enables measurement of current vs. voltage $I(V)$ and tunneling magnetoresistance (TMR) vs. magnetic field characteristics. Voltage across a MTJ is set by a source with 0.5 mV resolution and $\pm 1V$ range. Junction's current is measured in ± 20 mA range with 0.25 μA resolution. As a magnetic field source, Helmholtz coils supplied by current power supply are used. They enable 10 μT field resolution within ± 18 mT range. Automatic measurement procedure was implemented in LabVIEW. Microposition probes enable measurements of devices without necessity of bonding.

Test measurements were carried out with two MTJs fabricated at INESC-MN. MTJs consist of following materials (thicknesses in nm): substrate – glass, buffer layers - Ta5/Ru18/Ta3, antiferromagnet – PtMn18, synthetic antiferromagnet – CoFe2.2/Ru0.9, bottom electrode – CoFeB3, tunneling barrier -MgO1.35, free layer – (top electrode) CoFeB(t), capping layers – Ru5/Ta5/TiWN15. The difference between two samples is thickness of the top electrode, $t = 1.55$ nm and 3 nm, respectively. Both samples were annealed in 330 °C for 1 hour in 5kOe magnetic field.

Sample with thinner free layer (top electrode) manifests lack of hysteresis and very high sensitivity in linear range, therefore it has very good advantages of magnetic field sensor [1]. Other MTJ samples have typical hysteresis loop with TMR value reaching 170 %.

[1] P. Wiśniowski, J. M. Almeida, S. Cardoso, N. P. Barradas, and P. P. Freitas, *J. Appl. Phys.*, **103**, 07A910 (2008).

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