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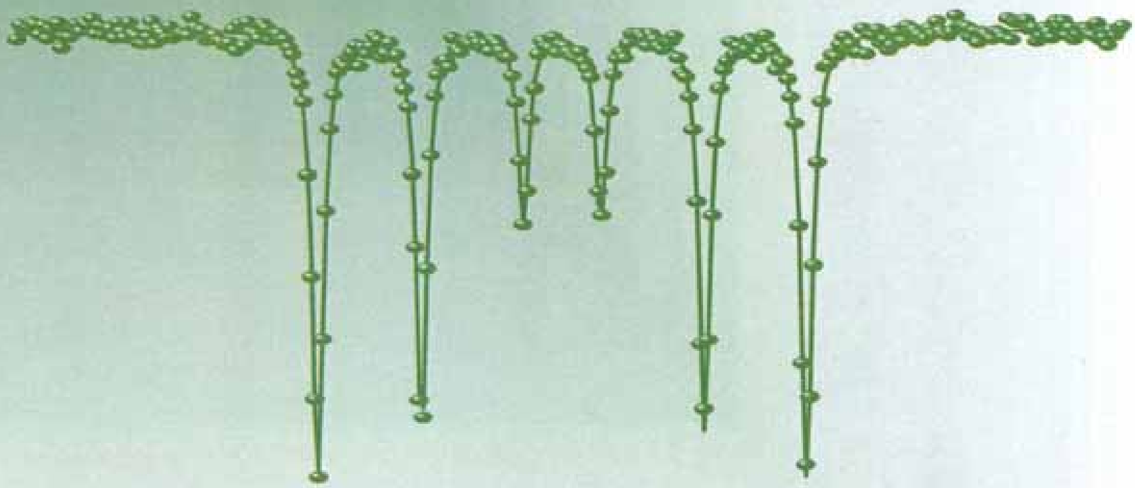

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Fabrication of Fe_3O_4-based magnetic tunnel junctions by MBE system

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Half-metal materials provide 100 % spin-polarized conductions and it is expected to induce a large tunnel magnetoresistance in magnetic tunnel junctions.[1] Magnetic tunnel junctions using half metallic magnetite (Fe_3O_4) have been fabricated on α-Al_2O_3 (0001) and MgO (100) substrates by a molecular beam epitaxy (MBE) system. We investigated the structure and chemical properties of interfaces in ferromagnet–insulator–ferromagnet (Fe_3O_4/I/Fe, I=MgO, Al_2O_3) tunnel junctions. The Fe_3O_4 quality was examined by reflection high-energy electron diffraction (RHEED), x-ray diffraction (XRD), superconducting quantum interference device (SQUID) magnetometer, atomic force microscopy (AFM), and *in situ* x-ray photoelectron spectroscopy (XPS). The results of reflection high-energy electron diffraction (RHEED) and x-ray diffraction (XRD) showed the good epitaxial growth of Fe_3O_4 layer with flat surface at T_s = 250 ℃ and $P(O_2)$ = 3×10^{-3} Pa. In magnetization measurement of multilayer Al/Ag/Fe_3O_4 sample, clear Verway transition indicating stoichiometric Fe_3O_4 is observed at around 120 K. By *in situ* XPS analysis methods, the Fe $2p_{3/2}$ and Fe $2p_{1/2}$ peak profiles for Fe_3O_4 layer are little changed by overlaying MgO, however, overlaying metal Al for Al_2O_3 barrier make the Fe 2*p* XPS profile in Fe_3O_4 change drastically. AFM data showed that the Fe_3O_4 surface governs the interface roughness in this Al/Ag/Fe_3O_4/MgO/Fe sample for magnetite-based tunnel junctions. These results suggest the Al/Ag/Fe_3O_4/MgO multilayers available for spin-dependent tunnel junction.

[1] P. J. van der Zaag, P. H. Bloemen, J. M. Gaines, R. M. Wolf, P. A. A. van der Heijden, R. J. M. van de Veerdonk, and W. J. M. de Jonge, J. Magn. Magn. Mater. 301, 4768 (2000).

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