GIANT ROOM-TEMPERATURE TMR EFFECT IN MAGNETIC TUNNEL JUNCTIONS WITH MgO(001) TUNNEL BARRIER

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Magnetic tunnel junctions (MTJs) consisting of ferromagnetic electrodes separated by a tunnel barrier exhibit the tunneling magnetoresistance (TMR) effect. While a magnetoresistance (MR) ratio up to 70% has been obtained at room temperature (RT) in MTJs with an amorphous Al-O tunnel barrier, a much higher MR ratio is theoretically expected in fully-epitaxial MTJs with a crystalline MgO(001) tunnel barrier. We fabricated the fully epitaxial Fe(001)/MgO(001)/Fe(001) MTJs with MBE and micro-fabrication techniques and achieved a giant MR ratio up to 188% at RT.[1,2] We observed even higher MR ratio up to 271% at RT (353% at 20 K) in fully-epitaxial bcc Co(001)/MgO(001)/Fe(001) MTJs. We also fabricated MTJs consisting of a highly-oriented poly-crystalline MgO(001) barrier and amorphous CoFeB ferromagnetic electrodes with sputtering deposition technique. The CoFeB/MgO(001)/CoFeB MTJs also exhibited a giant TMR effect above 200% at RT.[3] A crystalline MgO(001) tunnel barrier seems to be essential for the giant TMR effect because an amorphous MgO tunnel barrier yielded a much lower MR ratio. These results are of great importance not only for industrial applications but also for the physics of spin-dependent tunneling.

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2) S. Yuasa *et al*.: Nature Mater. **3**, 868 (2004).
3) D. D. Djayaprawira *et al*.: Appl. Phys. Lett. **86**, 092502 (2005).

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