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Fabrication of Fe/MgO/Gd magnetic tunnel junctions

阪大院基礎工[1]，CREST[2]，○高橋 良彰[1]，塩田 陽一[1,2]，三輪 真嗣[1]，Frederic Bonell[1,2]，
水落 憲和[1,2]，新庄 輝也[1]，鈴木義茂[1,2]

Osaka Univ.[1], CREST[2], ○Yoshiaki T. Takahashi[1], Yoichi Shiota[1,2], Shinji Miwa[1], Frederic Bonell[1,2],
Norikazu Mizuochi[1,2], Teruya Shinjo[1], and Yoshishige Suzuki[1,2]

E-mail: takahashi@spin.mp.es.osaka-u.ac.jp

Gadolinium (Gd) is one of the most attractive materials due to its unique magnetic and electric properties. Several studies mentioned that the magnetization at the Gd surface (about 2 Å in ref. [2]) is anti-ferromagnetically coupled to the bulk one [1, 2]. Since interface contributions to tunnel magnetoresistance (TMR) are considerably stronger than those of the bulk [3], characterization of the TMR is one of the most effective methods for investigating the interface. However, there is no report on magnetic tunnel junctions (MTJs) with a pure Gd electrode, except for a scanning tunnel microscopy study on a Gd (0001) surface [4]. In this study, we have fabricated MTJs with a pure Gd electrode.

The structure of the MTJs is as follows: Fe (50 nm)/MgO (2 nm)/Gd (20 nm), which were deposited onto the single-crystal MgO (001) substrate by molecular beam epitaxy methods. As shown in Fig. 1, the crystallinity of the Gd film was characterized by reflection high energy electron diffraction (RHEED). The MTJs were patterned into 0.5×5 μm^2 junctions, using electron beam lithography and an Ar-ion milling technique. The resistance-area products (RAs) is 45.9 $k\Omega \cdot \mu m^2$ at RT. Figure 2 shows the TMR curves of the Fe/MgO/Gd MTJs under the bias voltage of 50 mV (measured at 10 K). The TMR ratio for in-plane field is around 2.4% at 3 kOe. The TMR effect was attributed to the spin-polarized tunneling between the Fe and Gd films.

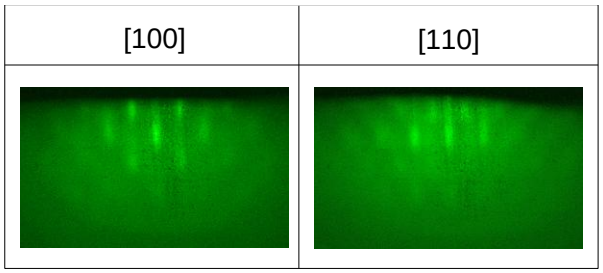

Fig. 1 RHEED pattern of the Gd overlayer along [100] and [110] azimuths of the MgO substrate

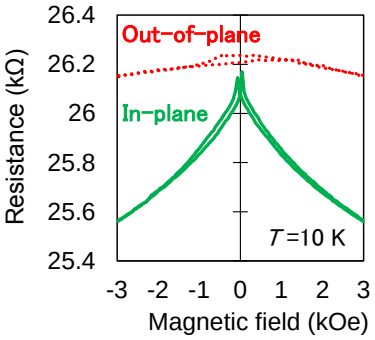

Fig. 2 TMR effect for in-plane field in the Fe/MgO/Gd MTJs measured at 50 mV, 10K

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References [1] D. Weller *et. al.*, *Phys. Rev. Lett.*, **54**, 1555 (1985).

[2] M. Heinemann *et. al.*, *Phys. Rev. B*, **49**, 4348 (1994). [3] T. Zhu *et. al.*, *Phys. Rev. B*, **66**, 094423 (2002).

[4] M. Bode *et. al.*, *Phys. Rev. Lett.*, **81**, 4256 (1998).