Magnetoresistance of Pt(001)/Fe-phthalocyaine/MgO(001) pseudo-epitaxial multilayer

阪大院基[1]，東北大院工[2]，JASRI[3]，阪大 CSRN[4]，東北大 CSRN[5]

○下瀬弘輝[1]，榎涼斗[2]，蒲生寛武[2]，河辺健志[1]，塚原拓也[1]，小谷佳範[3]，豊木研太郎[3]，

中村哲也[3]，後藤穣[1,4]，鈴木義茂[1,4]，新田淳作[2,5]，好田誠[2,5]，三輪真嗣[1,4]

Osaka Univ.[1], Tohoku Univ.[2], JASRI[3], CSRN-Osaka[4], CSRN-Tohoku[5]

○K. Shimose[1], R. Enoki[2], H. Gamou[2], T. Kawabe[1], T. Tsukahara[1], Y. Kotani[3], K. Toyoki[3],

T. Nakamura[3], M. Goto[1,4], Y. Suzuki[1,4], J. Nitta[2,5], M. Kohda[2,5], and S. Miwa[1,4]

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

Transition-metal-phthalocyanine (Pc) molecules have been explored for novel materials in spintronics because of its unique magnetic properties [1]. However, the magnetic properties of the Pc molecules have been done with localized techniques such as scanning probe microscopy, and there have been few reports characterized by electric conduction in devices [2]. In this study, we have employed pseudo-epitaxial metal/Pc interface [3], and have characterized its magnetoresistance to study interaction between spins in Pc and conduction electron in metal.

A single-crystal multilayer of fcc-MgO(001) substrate/fcc-MgO(001) (5 nm)/fcc-Pt(001) (6 nm)/Fe-phthalocyanine (FePc) (0, 0.32 nm)/fcc-MgO(001) (2 nm) was prepared (Fig.1). The multilayer device was fabricated with a channel length of 40 μm and width of 10 μm. FePc-0.32-nm corresponds to about one molecular layer of the FePc. Figure 2 shows the device resistance under magnetic field (H) perpendicular to the film plane. In the spectra in Fig. 2, normal magnetoresistance (MR) ($\propto H^2$) was subtracted as a background. As shown in Fig. 2(a), Pt/MgO device shows MR which indicates weak anti-localization similar with the previous study [4]. When the FePc was introduced at Pt/MgO interface, MR changes as shown in Fig. 2(b). Since significant change in MR was not observed in metal-free Pc (Pt/H_2Pc/MgO device, not shown), these results demonstrate that conduction electron in Pt and spin in FePc are interacted with each other. A part of this work was supported by JSPS KAKENHI (Nos. JP15H05420, JP26103002).

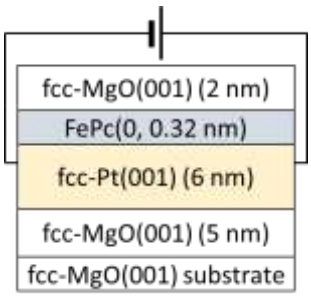


Fig. 1. Sample structure

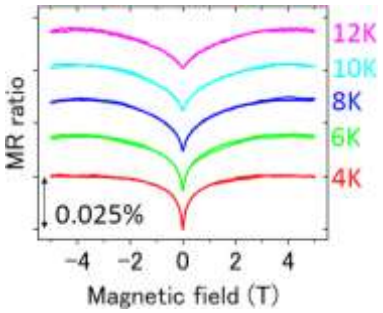
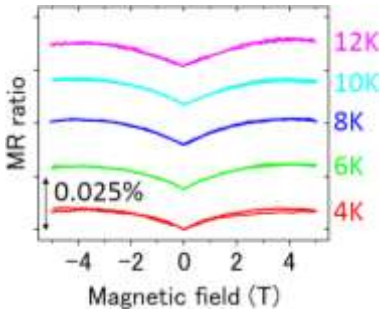


Fig. 2 (a) Pt/MgO device



(b) Pt/FePc/MgO device

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