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

阪大院基1, 東北大院工2, JASRI3, 阪大CSRNM4, 東北大CSRNM5

O下瀬弘輝1, 橋渡斗2, 藤生寛武2, 河辺健志1, 塚原拓也1, 小谷佳範3, 灘木研太郎3, 中村哲也3, 後藤穣1,4, 鈴木義茂1,4, 新田淳作2,5, 豊木研太郎3, 好田誠2,5, 三輪真嗣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) (∝H²) 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/H₂Pc/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).