

Perpendicular magnetic anisotropy of epitaxially grown Fe/Bi/MgO multilayer

阪大院基礎工 〇宮風 里紗, 縄岡 孝平, 田中 和仁, 後藤 穰, 鈴木 義茂, 三輪 真嗣

Osaka Univ. R. Miyakaze, K. Nawaoka, K. Tanaka, M. Goto, Y. Suzuki and S. Miwa

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

It is important to control magnetization direction for developing nonvolatile random access memory using nanomagnets. Voltage controlled magnetization anisotropy (VCMA) in Fe(Co)/MgO systems [1] can reduce the energy consumption compared with current-induced magnetic field and spin-transfer effect. [2] Therefore it is promising to control magnetization direction. However, the reported VCMA is too small to control magnetization direction with enough thermal stability. Interfacial magnetic anisotropy and VCMA are correlated to spin orbit interaction. Bi has large spin orbit interaction, so we have employed Bi to enhance VCMA. As an initial experiment, we tried epitaxial growth of Bi thin film on Fe(001) and characterized its perpendicular magnetic anisotropy.

A MgO(001) substrate/MgO(5 nm)/V(30 nm)/Fe(0.5 nm)/Bi(3 nm) multilayer was fabricated by molecular beam epitaxy as shown in Fig. 1(a). Crystallinity of each layer was characterized by reflective high energy electron diffraction. (RHEED). Figure 1(b) is RHEED image of 3-nm-Bi where incident electron beam is in MgO[110] direction. We found that Bi was epitaxially grown on Fe(001). Bulk structure of Bi is rhombohedral and its lattice constant is 4.5332 Å. [3] Meanwhile, epitaxially grown 3-nm-Bi film on Fe(001) is simple lattice whose in-plane lattice constant was estimated to be 3.2 Å. Next, we characterized perpendicular magnetic anisotropy in similar V/Fe/Bi/MgO multilayers. In the presentation, crystal structure of Bi characterized by RHEED and x-ray diffraction and its perpendicular magnetic anisotropy characterized by magneto-optical Kerr effect will be discussed in detail.

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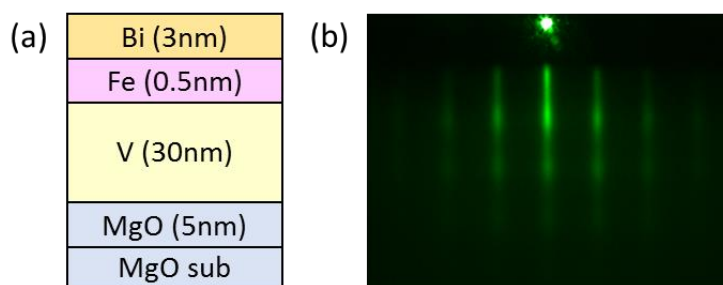


Fig. 1 (a) Schematic of multilayer structure. (b) RHEED image of 3-nm-Bi on Fe (001)

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[3] Ph. Hofmann, Progress in Surface Science **81**, 191 (2006)