Voltage control of magnetic anisotropy in Mn inserted Magnetic tunnel junction

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To realize the low energy consumption magnetic memory which employs tunnel magnetoresistance (TMR) effect, it is essential to control the direction of magnetization efficiently. Voltage controlled magnetic anisotropy (VCMA) has recently been attracting much attention as low power consumption technique because it doesn't require the electric current. Recently, it was reported that Cr insertion between the Fe/MgO interface enhances voltage-induced magnetic anisotropy change [1]. As the origin of this effect, it can be considered that Cr is playing the role of hole-doping at Fe/MgO interface because Cr has less electron than Fe does [2]. Mn also has possibility to enhance VCMA effect. VCMA of Mn inserted system has not been researched, while VCMA of Mn grown on paramagnetic material was reported [3]. In this research, we have characterized the voltage induced magnetic anisotropy of Fe|Mn|MgO multilayer.

An epitaxially grown multilayer MgO (001) substrate/V (30nm)/Fe (0.5nm)/Mn (0-0.149nm)/MgO (1.4 nm)/Fe (10nm) was fabricated by a molecular beam epitaxy. Multilayer was patterned to magnetic tunnel junction (MTJ) with a size of 10 μm^2 by photolithography and Ar ion milling (Fig1). TMR was measured under various bias voltage in in-plane magnetic field. Figure 2 shows the bias voltage dependence of TMR curves at the Mn thickness of 0.075nm. TMR ratio of Mn inserted MTJ reached to around 52%. We observed that MR curves was changed by applied bias voltage, which means the magnetic anisotropy in the Mn inserted MTJ was changed by bias voltage.

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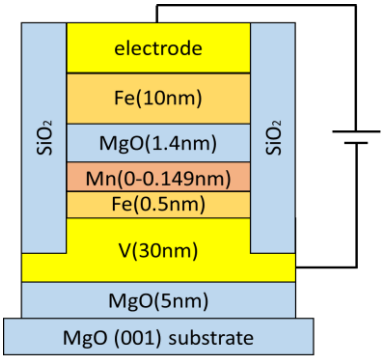

Fig.1 Multilayer structure

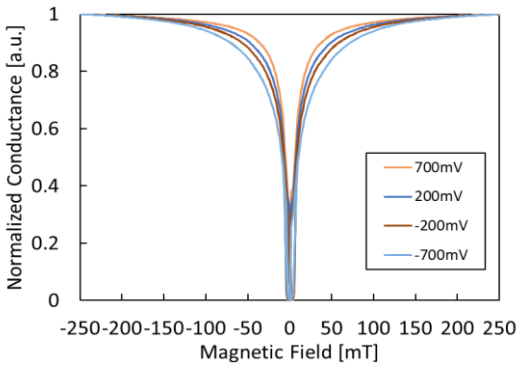

Fig.2 Normalized Conductance measured at various voltage

[1] A. Kozioł–Rachwał *et al.*, Sci. Rep. **7**, 5993 (2017) [2] Jia Zhang *et al.*, Phys Rev. B **96**, 014335 (2017) [3] K. Z. Suzuki *et al.*, ACS Appl. Mater. Interface **10**, 43305-43310 (2018)