Perpendicular magnetic anisotropy and tunnel magnetoresistance in magnetic tunnel junctions with a Mn nano-layer electrode

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Mn-based nano-layer films with large perpendicular magnetic anisotropy (PMA) and small saturation magnetization (M_s) are attractive for an electrode materials of magneto-resistive random access memory(MRAM) with high recording capacity and high frequency devices.[1-6] In this presentation, we report CoGa/ Mn electrode for the magnetic tunnel junctions exhibits high PMA and tunnel magnetoresistance(TMR) at room temperature.[7] The stacking structure of MTJs was MgO(001)sub./Cr(40)/CoGa(30)/Mn(0.7)/MgO(2.4)/CoFeB(1)/Ta(3)/Ru(5) (thickness in nm). Figure 1 shows out-of-plane hysteresis curve of MTJs stack without top ferromagnetic layer. Clear and well squared out-of-plane hysteresis curve with quite small M_s of 25 kA/m was observed. The MTJs using CoGa/Mn electrode showed negative TMR with applying an out-of-plane and in-plane magnetic field, as shown in Fig.2. The shape of the TMR curves suggests the CoGa/Mn electrode has the perpendicular easy axis with large PMA field over 19 T. In addition, the bias voltage dependence of the in-plane TMR curves suggested the PMA filed was modulated by magnitude of bias voltage. These results suggests that the pure-Mn nano-layer grown on CoGa seed layer can be promising for new nano-layer electrode, which can be realized the p-MTJs for MRAM with ultra-high recording capacity. This work is in part supported by the ImPACT program, KAKENHI (17K14103), the Asahi Glass Foundation, and the Sasakawa Foundation.

***Reference*:** [1] S. Mizukami et al, Phys. Rev. Lett. 106, 117201 (2011). [2] K.Z. Suzuki *et al.*, Jpn. J. Appl. Phys. (RC) **55**, 010305 (2016). [3] K. Z.Suzuki *et al.*, Sci. Rep. **6**,30249 (2016). [4] A. Ono et al. Appl. Phys. Express 10,023005 (2017). [5] S. Tsunegi et al. Appl.Phys. Lett.112, 262408 (2018) [6] K.Z. Suzuki et al., Appl. Phys. Lett. 112, 062402 (2018). [7] K. Z. Suzuki et al. ACS Appl. Mater. Interfaces 10, 43305 (2018)

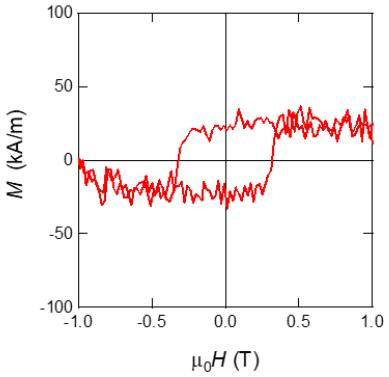

Fig. 1. Magnetization curve of CoGa/Mn/MgO structure measured at room temperature.

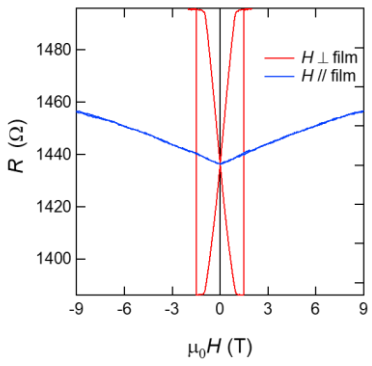

Fig. 2. Room temperature TMR curves with magnetic field (H) for out-of-plane and in-plane

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