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Spin-Polarized Current Switching of Co/Cu/Py Elongated Pac-Man Spin-Valve

A. Lyle¹, Y. K. Hong^{1*}, B. C. Choi², G. S. Abo¹, M. H. Park³,
S. H. Gee⁴, J. Jalli¹, and G. W. Donohoe⁵

¹MINT Center and Department of Electrical and Computer Engineering, University of Alabama, Tuscaloosa, Alabama 35487, USA

²Department of Physics and Astronomy, University of Victoria, Victoria, Canada V8W 3P6

³Western Digital Corporation, Fremont, California, USA

⁴Seagate Technology, Bloomington, Minnesota, USA

⁵Department of Electrical and Computer Engineering, University of Idaho, Moscow, Idaho 83844, USA

*Corresponding author: Yang-Ki Hong, e-mail: ykhong@cng.ua.edu

For the application of magnetic random access memory (MRAM) inter-element interactions due to stray magnetic fields should be minimized to achieve high aerial density and reliability [1, 2]. We previously reported that array of elongated Pac-man (EPM) $\text{Ni}_{80}\text{Fe}_{20}$ (Py) elements reveals closed magnetization configuration and results in negligible interaction between the elements during magnetic field switching [3-5]. In this study, we have performed micromagnetic simulations on EPM spin-valve (Co/Cu/Py) nanopillar structure, shown in Fig. 1(a), as a function of pico-second ranged pulse-width to investigate pulse-width dependence of spin-polarized switching current. Figure 1(b) shows an example of parallel to anti-parallel (P-AP) switching for a 300 ps pulse-width. The first snap-shot in red color corresponds to the Py free layer just before the pulse is applied. As shown in the image at 278 ps the switching occurs coherently without undergoing quasi-stable

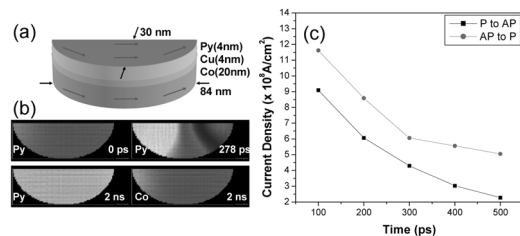


Fig. 1. (a) Schematic of Co/Cu/Py EPM spin-valve, (b) snap-shots of the nonequilibrium states of Py magnetization during P-AP switching for 300 ps pulse, and (c) spin-polarized switching current as a function of pulse duration.

successfully switched EMP spin-valve by spin-polarized current. This result implies that Pac-man shape is a good candidate shape for spin-valve of STT-RAM device.

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REFERENCES

- [1] J. Janesky *et al.*, *IEEE Trans. on Mag.*, **37**(4), 2052 (2001).
- [2] S. Tehrani *et al.*, *Proc. of IEEE*, **91**(5), 703 (2003).
- [3] M. H. Park, *et al.*, *J. of Appl. Phys.*, **95**(11), 7019 (2004).
- [4] B. R. Pujada *et al.*, *J. of Appl. Phys.*, **96**(8), 4362 (2004).
- [5] H. Han *et al.*, *IEEE Trans. on Mag.*, **41**(11), 4341 (2005).

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Exchange Coupling in FePt/Os/FePt Trilayers

Shih-Yuan Chen¹, Yeong-Der Yao², Yung-Hsiang Teng³, and Chin-Chung Yu^{3*}

¹Materials Science and Engineering, National Tsing Hua University, Hsinchu, Taiwan

²Materials Engineering, Tatung University, Taipei, Taiwan

³Applied Physics, National University of Kaohsiung, Kaohsiung, Taiwan

*Corresponding author: Chin-Chung Yu, e-mail: M9003505@mail.ntust.edu.tw

Effects of the Os layer on the magnetic properties of FePt(10nm)/Os(xnm, $x = 0 \sim 2.7$)/FePt(10nm) were investigated. The magnetic layer of FePt in the as-deposited Ta/FePt/Os/FePt/Ta thin films exhibited very strong (111) orientation in all the cases. As the thickness of Os spacer layer between 0.1 and 0.3 nm, it appears an antiferromagnetic exchange coupling (AFC) behavior in the hysteresis loop as shown in Fig. 1(a). The exchange coupling transforms to ferromagnetic when the thickness of Os spacer layer was thicker than 0.4 nm. The second maximum of AFC is found as Os thickness = 0.7 nm. Although the J value for FePt/Os/FePt thin films is 0.22 erg/cm², which is relatively small than that of Co/Ru system, the GMR effects could be observed. The oscillatory behavior of GMR value is sketched in Fig. 1(b). In general, the AFC in multilayer system shows the first maximum of AFC peak occurring at spacer thickness between 0.8 and 1.1 nm for most spacer materials. In our investigation, this is the first time that a clear AFC behavior observed in FePt/Os/FePt system with Os spacer thickness at 0.2nm. Except for the longitudinal MR, we also measure the perpendicular MR (PMR). We do not observe explicit PMR effect for the films with the thickness of Os layer ranged from 0.1 ~ 0.3 nm. A negative PMR is observed in the film with Os thickness= 0.4 nm. Because the FePt layers do not possess a perpendicular magnetic anisotropy, it indicates a perpendicular AFC in the FePt/Os(0.4nm)/FePt system. For the rest of the films, a positive PMR is observed.

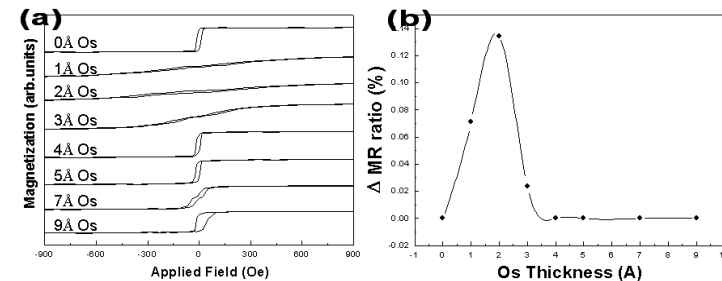


Fig. 1. (a) The M-H loops of FePt/Os/FePt thin films with various Os spacer thickness. (b) Relationship between ΔMR ratio and Os thickness.