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Reversal-mechanism of in-plane current-induced perpendicular switching: the role of controllable domain behaviors C. BI, Institute of Microelectronics, Chinese Academy of Sciences, Beijing 100029, China, J.Q. XIAO, Department of Physics and Astronomy, University of Delaware, Newark, Delaware 19716, USA, M. LIU, Institute of Microelectronics, Chinese Academy of Sciences, Beijing 100029, China — We propose a magnetization reversal model to explain the perpendicular switching of a single ferromagnetic layer induced by an in-plane current [1]. Our model includes three ingredients: (1) a steady equilibrium magnetization state with equal up and down domains favored by an applied current; (2) domain Wall (DW) motion under the applied current; (3) the up-down (↑↓) DW and down-up (↓↑) DW motions are separately modulated by an applied field. We experimentally demonstrate ingredient (1) can be satisfied in symmetric Pt/Co/Ni/Co/Pt and asymmetric Pt/Co/AlOx structures arising from the magnon instability induced by conventional spin torques [2] and probable spin-Hall torques (SHT) in asymmetric structures. We show ingredient (2) and (3) can also be satisfied in these structures. This model indicates that SHTs mainly play the role of driving DW motion, and a required external field plays the role of modulating the relative velocity of ↑↓ and ↓↑ DWs and thus determines the switching directions. This model also predicts similar switching behaviors in skyrmion structures. [1]L. Liu et al. Science 336, 555 (2012);[2] J. Shibata et al. Phys. Rev. Lett. 94, 076601 (2005).

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