Out-of-plane Magnetization Switching due to In-plane Current Pulse in Pt/Co/Pt Nanowires with Perpendicular Magnetic Anisotropy

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We report here the current-induced magnetization switching in metallic ferromagnetic Pt/Co/Pt nanowires, which exhibits strong perpendicular magnetic anisotropy. In this experiment, an in-plane magnetic field along the nanowire is applied and then, the current pulses either parallel or antiparallel to the in-plane magnetic field are injected into the nanowire. Interestingly, the out-of-plane magnetization of the nanowire is switched with respect to the polarity of the in-plane current pulses, as clearly seen in Fig. 1. The switching direction is found to be dependent on the relative thicknesses of the upper and lower Pt layers, as shown in Fig.1 for (a) 2.5-nm Pt/0.3-nm Co/1.5-nm Pt and (b) 2.5-nm Pt/0.3-nm Co/1.5-nm Pt nanowires. These behaviors can be explained by the current-induced out-of-plane effective field, which has been recently proposed from the experiments on metal/oxide systems such as Pt/Co/AlOx [1,2] and Ta/CoFeB/MgO [3]. However, it is interesting to see that even the almost symmetric metal/metal systems also exhibit the same behavior. We will discuss the role of the Rashba spin-orbit coupling and the spin Hall effect as the possible origins of such effective field.

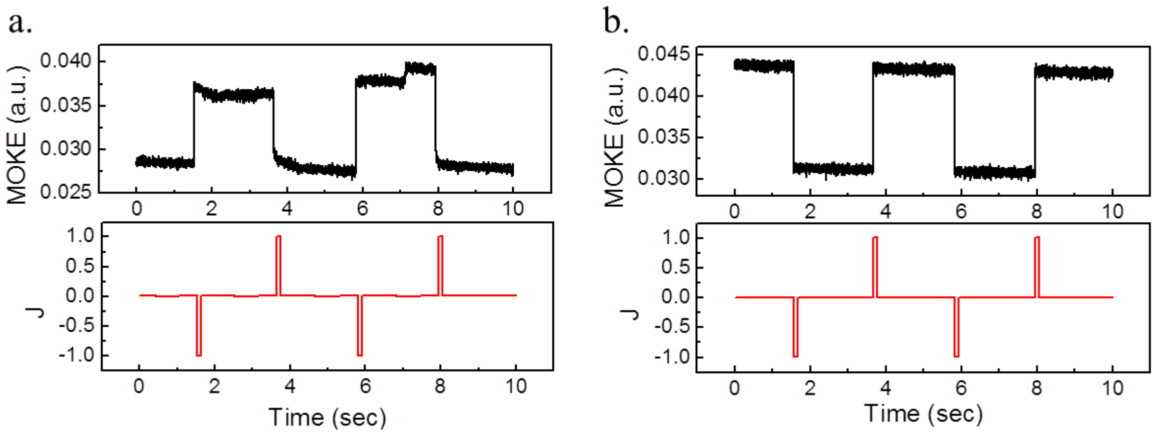

Fig. 1. Out-of-plane magnetization switching with respect to the in-plane current pulses with the current density J for (a) 2.5-nm Pt/0.3-nm Co/1.5-nm Pt and (b) 2.5-nm Pt/0.3-nm Co/1.5-nm Pt nanowires. The out-of-plane magnetization state is monitored by the magneto-optical Kerr effect (MOKE) signal from the nanowires.

참고문헌

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