AF-2-P17

Enhancement of Current Induced Magnetization Switching byan exchange-biased ferromagnetic lead with a nano-oxide layer

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Magnetic excitation by a spin-torque transferred from spin-polarized incoming electrons to local magnetizations has opened an attractive novel way of manipulating local spin direction in a magnet. The current induced magnetization switching (CIMS) has been observed at the current density of the order of 107 A/cm2 in trilayer spin-valves, and at one order higher in synthetic antiferromagnetic or in exchange biased spin-valves (EBSV). For the application, both low switching current density (105~106 A/cm2) and high output signal are essential. Here we show a great enhancement of the spin polarization and eventually the spin-torque when unpatterned and magnetically pinned ferromagnet having a nano-oxide layer (NOL) within it is adopted as a lead. In this structure, the switching current density (4x106 A/cm2) is only ~10% and the resistance change (193 mΩ) is ~275% of those in a typical trilayer spin valve with similar layer thicknesses. Taking into account both current-in-plane (CIP) and current-perpendicular to-plane (CPP) transports, we are able to quantify an increase in the spin polarization by inserting NOL, which agrees with the experimental results. We believe employment of ferromagnetic lead and NOL in the fixed layer is a promising approach for the application of spin-valves in a real CIMS device since it simultaneously provides a sufficient low switching current density and a reasonable high output signal.