Ni-Co-based synthetic antiferromagnet for perpendicular magnetic tunnel junction

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Contemporary magnetic tunnel junctions (MTJs) designed for data storage rely on perpendicular magnetic anisotropy to achieve low switching current density and high thermal stability. The reference layer is typically pinned by a synthetic antiferromagnetic (SAF) structure based on less-abundant materials such as Pt or Pd [1]. Here, we propose a MTJ stack in which the SAF is based on Ni–Co superlattices. The reference layer exhibits a switching field exceeding 250 mT. MTJ nanopillars with diameters down to 80 nm show robust switching with voltage pulses from 1 ms to 5 ns, tunneling magnetoresistance (TMR) up to 140%, high thermal stability $\Delta \geq 50$, a switching current density of 2.6 MA/cm^2 and small bit-error rate. These results demonstrate the potential of MTJs based on abundant materials [2].

References:

[1] S. Mangin, et al. Nat. Mater. 5, (2006), 210
[2] M. Cierpiał, et al. Sci. Rep. 15, (2025) 35227

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