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Magnetoresistive devices for industrial applications: improvement of thermal robustness

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Tunnel magnetoresistance (TMR) sensors are promising for industrial applications due to their high sensitivity and large output signals, but reliable operation at elevated temperatures remains challenging. This work investigates the thermal robustness of TMR sensors by comparing three multilayer stacks with different antiferromagnetic layer thicknesses, tunneling barrier thicknesses, sensing multilayers and deposition techniques. Temperature-dependent magnetoresistance measurements were used to evaluate the evolution of TMR, sensitivity, resistance-area product, and reference system stability. In addition, the behavior of the cylindrical sensing layer was studied through the analysis of temperature-dependent vortex nucleation and annihilation fields. The results show a systematic degradation of performance with temperature, strongly influenced by the blocking temperature and loss of exchange bias. Re-annealing experiments demonstrate that this degradation is largely reversible, indicating that loss of exchange bias is the dominant mechanism limiting performance.

Field of Research/Work

Condensed Matter and Materials

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