Researchers use spin waves to measure magnetic polarization of electrical current

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In the hard drive industry, the rapid growth of storage density has been propelled in part by developments in the sensors used to read the magnetic "bits" on the disk. Recently, the use of giant magnetoresistance (GMR) in such sensors, with current flowing in the plane of a multilayer film, has given way to the use of tunneling magnetoresistance, where current flows perpendicular to the plane of the multilayer through a tunnel barrier.

To avoid the prohibitively high resistance of smaller tunnel junction sensors, future miniaturization of the sensors is projected to again require the use of GMR in all-metal multilayers, but with current flowing perpendicular to the plane.

In a collaboration with researchers at Hitachi Global Storage Technologies, CNST researchers used their recently developed spin wave Doppler technique to measure the current polarization in novel $(CoFe)_{1-x}Ge_x$ alloys being investigated for possible use in future disk drive read head sensors.

A critical parameter in determining the GMR of a multilayer sensor film is the current polarization, which is the degree to which the current carried in a magnetic metal is carried by electrons with spins either parallel or anti-parallel to the magnetization. The CNST researchers' measurement technique used nanostructured antennas to launch and detect spin waves in current-carrying $(CoFe)_{1-x}Ge_x$ stripes, allowing them to measure shifts of a resonant transmission frequency that

revealed the current-induced drift velocity of the magnetization and the current polarization.

The results indicate polarization up to 95 % in these alloys. Although comparable polarization values have been found in materials that require annealing at prohibitively high temperatures, the $(CoFe)_{1-x}Ge_x$ alloys are compatible with sensor manufacturing.

More information: Enhanced magnetization drift velocity and current polarization in (CoFe)1−xGex alloys, M. Zhu, B. D. Soe, R. D. McMichael, M. J. Carey, S. Maat, and J. R. Childress, *Applied Physics Letters* 98, 072510-072510-3 (2011).

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