Magnetic Energy Loss Scaling in Permalloy Thin Film Microstructures

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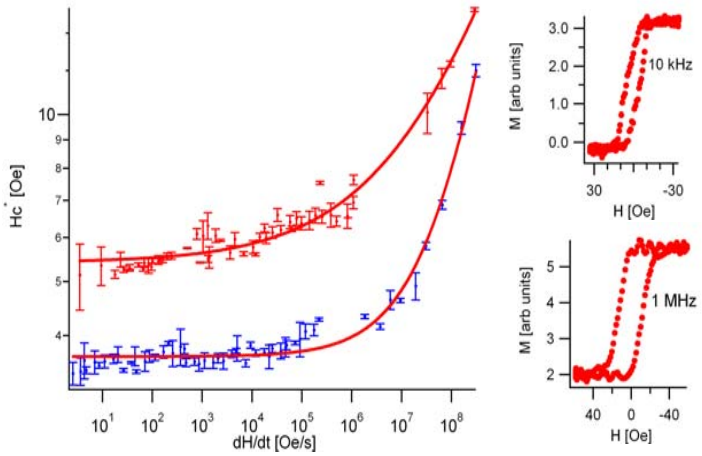
Scientific Issue: Magnetic switching is accompanied by energy loss which can limit the performance of magnetic devices, especially at high frequencies. The fundamental mechanisms responsible for the transfer of energy from electron spins (the basis for ferromagnetism) to the lattice, where it is carried away as heat, is not well understood.

Objective: This research seeks a better understanding of magnetic switching loss by exploring the loss scaling as a function of drive field amplitude and frequency over a very wide range of these parameters.



Measured magnetic energy loss scaling of permalloy thin films and thin film based microstructures covering over eight decades in frequency. Insets show hysteresis loops at 10 kHz and 1 MHz. (Loop area is equal to energy loss.)

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Progress: We have shown that the loss scaling (refer to figure) can be fit by a function: loss = $H_c + A(dH/dt)^{\alpha}$ which can be obtained from a microscopic model of the domain wall motion.

Submitted Paper: C. Nistor, E. Faraggi and J.L. Erskine "Magnetic Energy Loss in Permalloy Thin Films and Microstructures," Phys. Rev. Letters.

Education: Two graduate students, Corneliu Nistor and Shuquan Yang are working on this project.

Outreach: An undergraduate student, Jeremy Jarl, from Southwest Texas State, participated in this project.

Undergraduate student Jeremy Jarl presenting the results from his Research Experience for Undergraduates (REU) project, summer 2003.