Materials Science & Engineering Seminar Series

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presents

Damping in Epitaxial Magnetic Metals and Oxides

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ABSTRACT: Precession of magnetization in all real materials undergoes "damping," analogous to damped mechanical oscillations with friction. Minimizing magnetic damping is crucial for engineering spintronic devices (e.g., nanoscale magnetic memories and signal generators) that can be operated with low power input. However, the mechanisms of damping in various materials – even in the simplest ferromagnetic metals – have yet to be understood.

In this talk, I will present our recent experimental efforts that provide new insight into magnetic damping in two distinct model-system materials, i.e., epitaxial thin films of metallic Fe and insulating spinel ferrites. For epitaxial Fe, damping at room temperature is remarkably insensitive to the crystalline quality (i.e., coherently strained vs. partially relaxed), although at low temperature higher crystalline quality leads to significantly higher damping. Our results show that damping is related to the electrical conductivity of epitaxial Fe in a way that cannot be fully explained by classical eddy current loss, thus pointing to an intraband scattering mechanism [1] as a key origin of damping. For epitaxial ferrites, we find that while the intrinsic chemistry of magnetic cations plays a role in damping [2], the crystalline quality of films has a much more pronounced impact on damping. Our studies may yield important hints for engineering low-damping materials for power-efficient spintronic devices.

[1] K. Gilmore, Y. U. Idzerda, M. D. Stiles, Phys. Rev. Lett. 99, 027204 (2007); M. A. W. Schoen *et al.*, Nat. Phys. 12, 839 (2016).

[2] S. Emori *et al.* Nano Letters, 18, 4273 (2018).

BIOGRAPHY: Satoru Emori is an Assistant Professor in the Department of Physics at Virginia Tech. He received his B.S. in Materials Science and Engineering at the University of California, Irvine in 2008 and Ph.D. in Materials Science and Engineering at the Massachusetts Institute of Technology in 2013. His doctoral thesis work investigated the motion of chiral domain walls in ultrathin metallic ferromagnets. Following his postdoctoral work at Northeastern University and Stanford University, where he studied magnetization dynamics in complex oxide materials, he joined the faculty of Virginia Tech in Fall 2017. His new research group [homepage] is focused on spin transport and dynamics in model thin-film materials, ranging from amorphous metals to epitaxial oxides.
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