Pumping Iron (and Nickel): Magnetic Damping and Spin-Orbit Torque in Vertically Graded FeNi Alloys

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Energy-efficient spintronic devices require a large spin-orbit torque (SOT) and low damping to excite magnetic precession. In conventional devices based on heavy-metal/ferromagnet bilayers, reducing the ferromagnet thickness to ~1 nm enhances the torque – but with the tradeoff of high damping.

I will present my team’s new approach toward attaining low damping and a sizable SOT in single-layer, 10-nm-thick FeNi alloys. A vertical Fe:Ni compositional gradient is designed to provide the necessary asymmetry for SOT generation. We confirm low effective damping in FeNi even with a steep compositional gradient. More remarkably, we reveal a sizable anti-damping SOT even without any intentional compositional gradient. Through noninvasive depth-profile measurements, we identify a lattice strain gradient as the key asymmetry giving rise to the SOT. Our findings provide fresh insights into damping and SOTs in single-layer ferromagnets for power-efficient spintronic devices.

Biography

Satoru Emori is an Associate 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 his Ph.D. in Materials Science and Engineering at the Massachusetts Institute of Technology in 2013. Following his postdoctoral work at Northeastern University and Stanford University, he joined the faculty of Virginia Tech in Fall 2017. His research aims to understand and control magnetism and spin dynamics in thin-film media, which have the potential to enable energy-efficient memories and computers. He received a National Science Foundation CAREER Award in 2022, was selected as an APS Outstanding Referee in 2024, and is now serving as an IEEE Magnetics Society Distinguished Lecturer for the year 2024.
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