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Reversal mechanism of patterned ferromagnetic elements[1] YIMEI ZHU, J.W. LAU, V.V. VOLKOV, Brookhaven National Lab, CFN TEAM — Understanding of magnetization reversal dynamics in patterned ferromagnetic elements, or building blocks, is crucial to the development of modern magnetic storage media and spintronic devices. Using state-of-the-art, field-emission transmission electron microscope (TEM) equipped with a custom-made objective lens (the only one of its kind in the world) that allows high-resolution magnetic imaging and electron holography, we study the reversal mechanism and hysteresis behavior of patterned rings, squares, and ellipses with different aspect ratios of Permalloy and Co thin-films. By quantitative analysis of the local magnetization, we measure magnetic properties and shape effect of individual elements, and compare experimental observations with theoretical calculations. We explain why a parent state of the elements, isolated or in an array environment, can result in different low-energy ground states, depending on the switching rate, and how the energy barrier to the vortex nucleation can be measured. New results using a magnetic force microscope built into a TEM stage to locally induce magnetic field gradient and to change magnetic polarization of the elements to study element-element interaction and magnetic reversal will be also reported.

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