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Neutron-scattering determination of local magnetic structure in patterned thin-film devices BRIAN MARANVILLE, KATHRYN KRYCKA, JULIE BORCHERS, NIST, CAROLINE ROSS, CHUNGHEE NAM, Dept. MSE, Mass. Inst. of Tech., ADEKUNLE ADEYEYE, Dept. ECE, NUS, Singapore, NATHANIEL WRIGHT, CHRISTOPHER METTING, Univ. of Maryland — The performance of devices based on patterned magnetic films depends strongly on the uniformity of the magnetic state of individual magnetic elements across the whole device. Characterization with scattering techniques provides an ensemble average over a large spatial region, ideal for studies of this kind. We present off-specular neutron scattering measurements on patterned magnetic films of permalloy. Interpretation of the results involves a novel modeling technique, first determining likely magnetic configurations of the elements from micromagnetic modeling (using OOMMF software) followed by direct calculation (in a modified Born Approximation) of the expected neutron scattering from an ensemble of such elements. Two different element shapes (ring and c-shaped, $\sim 1\mu$m long, 20nm thick) were measured, modeled and contrasted. In the closed ring structure the vortex ground state lacks preferred chirality, while in the c-shape the chirality can be controlled over the whole device. The signature of these states in the neutron scattering is distinct and has applications, e.g. for novel layered storage media, in which the magnetic structure is inaccessible to other, direct-mapping microscopy techniques.

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