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Neutron Diffuse Reflectometry of Magnetic Thin Films with a 3He Analyzer WANGCHUN CHEN, NIST and Indiana University, KEVIN O'DONOVAN, NIST and University of Maryland, JULIE BORCHERS, PHILIPPE MANGIN, CHARLES MAJKRZAK, THOMAS GENTILE, NIST — Polarized neutron reflectometry (PNR) is a powerful probe that characterizes the magnetization depth profile and magnetic domains in magnetic thin films. Although the conventionally used supermirrors are well-matched for specular PNR, they have limited angular acceptance and hence are impractical for complete characterization of the magnetic off-specular scattering where polarization analysis for diffusely reflected neutrons is required. Polarized ^{3}He gas, produced by optical pumping, can be used to polarize or analyze neutron beams because of the strong spin dependence of the neutron absorption cross section for ^{3}He. Here we report efficient polarization analysis of diffusely reflected neutrons in a reflectometry geometry using a polarized ^{3}He analyzer in conjunction with a position-sensitive detector (PSD). We obtained spin-resolved two-dimensional Q_x-Q_z reciprocal space maps for a patterned array of Co antidots in both the saturated and the demagnetized states. The preliminary results for a patterned amorphous bilayer, $Gd_{40}Fe_{60}$/ $Tb_{55}Fe_{45}$, measured with a ^{3}He analyzer and a PSD will also be discussed. Using the spin exchange optical pumping method we have achieved record high ^{3}He polarizations of 76% on the neutron beam line where we measured an initial analyzing efficiency of 0.97 and a neutron transmission for the desired spin state of 0.45.

Wangchun Chen
NIST and Indiana University

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