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Spiral-like magnetic state in exchange biased CoO/Co structures seen by waveguide-enhanced PNR

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Exchange bias phenomenon was intensively investigated and actively utilized in spintronics applications [1]. Perhaps, the archetypical CoO/Co structure is the most studied object by various methods, including neutron scattering [2-3]. Due to well studied properties, CoO/Co-based systems are used in many studies, including triplet spin valve effects in hybrid superconductor/ferromagnet heterostructures [4].

In this report we present results of polarized neutron reflectometry (PNR) of exhange biased CoO(20nm)/Co(1÷20nm) structures. In order to enhance sensitivity of neutron scattering to the magnetic state of the cobalt layer we have used special design of the structure, known as neutron waveguide. In the waveguide, the investigated magnetic layer is placed between the highly reflecting layer of CoO and the sapphire substrate. The Nb layer is used as a spacer for formation of neutron standing wave and also can be used for the study of the triplet spin valve effect [4]. The waveguide enhancement allowed us to measure neutron intensity of specular and off-specular scattering in four spin states. At low temperature, in certain region of magnetic fields, we have observed strong difference in reflectivities of two spin-flip channels in the waveguide mode (Fig. 1). Such a difference is typical for neutron scattering from non-complanar magnetic structures, like helicoids [5] or skyrmion [6]. The PNR measurements are complemented with transport and SQUID data. Possible explanation of the magnetic arrangment is discussed.

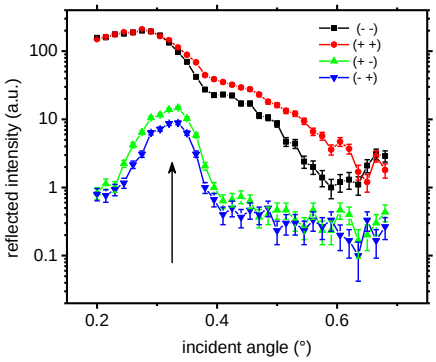

Fig. 1. Spin-polarized neutron reflectivity curves measured on sample CoO(20nm)/Co(4nm)/Nb(20nm)/Al_2O_3. Position of the waveguide mode is shown by vertical arrow.

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