Polarized neutrons for the analysis of magnetic thin films and superlattices

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In recent years polarized neutron reflectivity has played an essential role for the exploration of magneto- and spintronic nanostructures [1,2]. Well known systems extensively studied include exchange coupled magnetic superlattices [3,4], tuning of exchange coupling with hydrogen [5,6], exchange spring valves between soft and hard magnetic films [7], exchange bias systems between ferromagnetic and antiferromagnetic films [8,9], and more recently magnetic semiconductors [10] and ferromagnetic Heusler alloy films and superlattices [11]. In addition to studies of layered systems, neutron scattering has now also expanded in the direction of laterally structured magnetic media such as stripes and islands on the sub-micrometer scale [12-14]. Although the competition with x-ray resonant magnetic scattering (XRMS) has increased in recent years [15], there are some advantages PNR offers that are hard to challenge. Those are the analysis of the data with the Born approximation or with the distorted wave Born approximation (DWBA), the well known cross sections, and the magnetic spin flip scattering, which has no counterpart in XRMS. The latter one allows evaluation of magnetization fluctuations transverse to the neutron polarization axis and gives access to magnetic roughness and magnetic domain states. In this contribution I will exemplify specular and off-specular PNR work by most recent experiments on spintronic materials such as Heusler alloys [11] and from laterally patterned and functionalized magnetic layers [13].

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