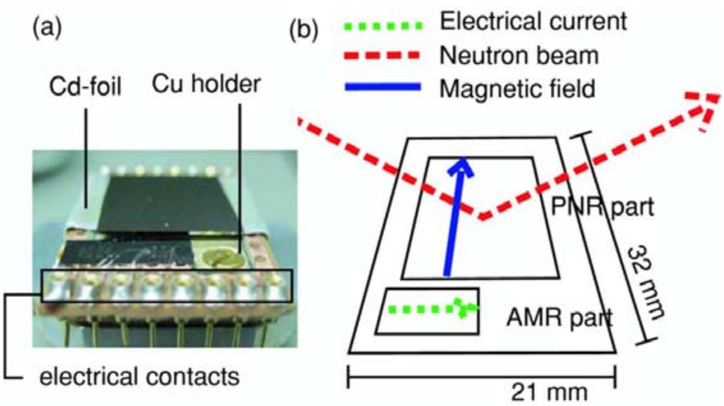
Simultaneous polarized neutron reflectometry and anisotropic magnetoresistance measurements

A novel experimental facility to carry out simultaneous polarized neutron reflectometry (PNR) and anisotropic magnetoresistance (AMR) measurements is presented. Performing both techniques at the same time increases their strength considerably. The proof of concept of this method is demonstrated on a CoO/Co bilayer exchange bias system. Although information on the same phenomena, such as the coercivity or the reversal mechanism, can be separately obtained from either of these techniques, the simultaneous application optimizes the consistency between both. In this way, possible differences in experimental conditions, such as applied magnetic field amplitude and orientation, sample temperature, magnetic history, etc., can be ruled out. Consequently, only differences in the fundamental sensitivities of the techniques can cause discrepancies in the interpretation between the two. The almost instantaneous information obtained from AMR can be used to reveal time-dependent effects during the PNR acquisition. Moreover, the information inferred from the AMR measurements can be used for optimizing the experimental conditions for the PNR measurements in a more efficient way than with the PNR measurements alone.

J. Demeter, A. Teichert, K. Kiefer, D. Wallacher, H. Ryll, E. Menéndez, D. Paramanik, R. Steitz, C. Van Haesendonck, A. Vantomme, and K. Temst, Rev. Sci. Instrum. **82**, 033902 (2011)



(a) Picture of the sample holder used for the simultaneous PNR and AMR measurements.

(b) Schematic representation of the directions of the magnetic field, the electrical current, and the neutron beam direction. The polarization of the neutrons is parallel to the magnetic field.

Right: Results of PNR magnetic field scans (upper panels) and the simultaneous (middle panels) and external (lower panels) AMR measurements. The columns correspond to the consecutive branches of the hysteresis loop: (a) virgin descending, (b) virgin ascending, (c) trained descending, and (d) trained ascending branch. The vertical lines indicate the crossing of the NSF signals and the peak in resistance in the PNR and AMR results, respectively, hence, the coercive fields. In the PNR measurements the four signals, *uu* (black filled circle), *dd* (blue filled square), *ud* (red open circle), and *du* (green open square) are shown.