Resonant X-ray Scattering of U/Fe Multilayers at XMaS Beamline

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Magnetic multilayers have been fabricated from many elements. When 3d elements are incorporated in the multilayer stack Giant Magneto Resistance (GMR) is often observed, notably in Fe/Cr, etc. A natural extension of the present multilayer research is to place 5f electrons in these structures. Their wide range of magnetic properties, from localised magnetism (as in UO_2) to itinerant ferromagnetism (as in UFe_2) makes this a rich and potentially important field.

We are now able to produce high quality U/Fe multilayers through DC sputtering. Here, we report on results obtained from a [U31Å/Fe25Å]x30 multilayer through resonant magnetic scattering performed on the XMaS beamline at the ESRF. The asymmetry ratio is defined as $(I^+-I^-) / (I^++I^-)$, where $I^+(I^-)$ is the normalised intensity obtained with circular polarisation and the applied field parallel (anti-parallel) to the beam direction. Asymmetry data will be presented as function of both energy and momentum transfer (**q**). We have identified a uranium moment (~20 % asymmetry ratio at 3.729 keV) with use of resonant magnetic reflectivity at 12 K. Temperature dependence measurements confirm that ~90% of this moment exists at room temperature. Qualitatively, the existing data indicates that the uranium moment is non-uniformly distributed with the layers. The data obtained on tuning the incident energy to a sharp dichroic feature at the Fe K edge also indicates a non-uniform distribution of hybridised Fe. In order to obtain a more quantitive model of the uranium moment distribution it is necessary to acquire acurate values for the absorptive and dispersive parts of the optical constants. To this end, linearly polarised reflectivity has been employed to provide energy and **q** dependent data around the uranium M_{IV} edge and at 7.0 keV. Code has been produced to simultaniously fit to multiple energy data sets using Kramers-kronig transforms of experimental fluorescence data to obtain the dispersive optical constant.