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Neutron coating development applied to non-depolarizing CuTi supermirror

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In the last two years the neutron optics group of FRM II has successfully sputtered non-depolarizing m=2 Cu/Ti supermirrors, which have been prepared with a standard DC magnetron sputtering facility. Control on the roughness grow and interdiffusion allowed us to get a very good maximum angle of total reflection (ca. 0.21°/λ) and polarized neutron reflectivity above 90%, as measured at the instrument GINA, located at BNC in Budapest. No difference between R+ and R- components was found within the statistical error bars. By using R+ and R- we were able to calculate the Spin Asymmetry (SA) of the sample defined as SA = (R+ - R-)/(R+ + R-).

The magnetic behavior of the Cu/Ti coating was checked by means of SQUID measurements at the WMI in Garching to be slightly ferromagnetic with magnetic moment of 10-3 Bohr-magneton/atom. For comparison, Ni/Ti and Ni(Mo)/Ti supermirrors were also measured, finding magnetizations of 0.55 Bohr-magneton/atom for Ni and 0.11 Bohr-magneton/atom for Ni(Mo), in agreement with data found in the literature.

By knowing the structure of the sample, the simulation programs GenX and SimulReflec were used to distribute the magnetization measured by SQUID along the whole supermirror structure in order to check which would be the theoretical SA delivered by such a model, and whether this could be compatible to the one measured experimentally. The result of such simulations denotes, besides some discrepancies, the compatibility of the theoretical model with the experimental SA result. Moreover, GenX and SimulReflec were also used to calculate the theoretical Spin Flip Reflectivity (i.e. depolarization) that this magnetization would deliver, finding a maximum value of a few times 10-6.

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