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Magnetic contrast layers with functional SiO2 coatings for soft matter studies with polarised neutron reflectometry

Our presentation introduces silicon substrates with a switchable magnetic contrast layer (MCL) for polarised neutron reflectometry experiments (PNR) at solid/liquid interface to study soft matter surface layers. Combination of PNR with MCL based on obtaining various reflectometry curves from the same structure with changing only one parameter. In "classical" soft matter experiments, this is H2O/D2O variation during the solvent contrast exchange procedure. In the presented MCL approach, this role is up to the magnetic SLD of the reference layer changing depending on the neutron polarization – parallel or antiparallel to the MCL magnetization. This technique expands the possibilities of PNR investigations of a wide range of structures, e.g. 2D objects with low scattering potential in air, polymer films, nanoparticles, etc.

We successfully produced and tested ready-to-measure silicon blocks of $50 \times 50 \times 10$ and $80 \times 50 \times 15$ mm3 coated with Fe/SiO2 thin film bilayers. Collected during laboratory and PNR attestation data showed high quality and repeatability of the MCL parameters, regardless of the substrate size and thickness of the capping SiO2 layers. As compared to other kinds of substrates with MCL, the SiO2 capping layer allows to reproduce the typical surface of the standard silicon substrate used for NR experiment and is compatible with a large variety of soft matter samples. We demonstrated such application, by using it in PNR experiments for the characterization of a lipid bilayer in a single solvent contrast.

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Instrumentation and methods

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