[reflectometry experiment]
(Chapter 5.5.4 in *Elements*)

How to carry out a reflectometry experiment

Several steps are required to determine the final reflectivity function and interpret the result.

Step 1. Record a background run, with the incident beam blocked by a neutron absorber, such as cadmium.

Step 2. Record a transmission run, without a sample in the beam to determine the incident neutron wavelength spectrum.

Step 3. Record a reflectivity run, with the sample in the beam at the appropriate scattering angle.

Figure 5-R1 illustrates.

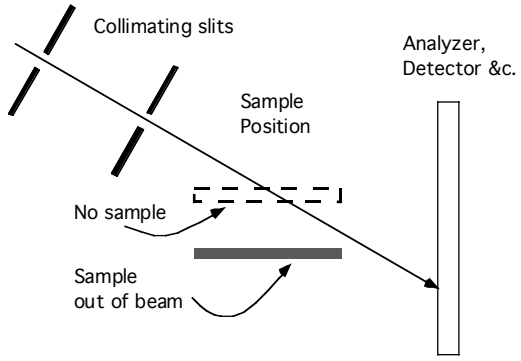

Figure 5-R. Schematic arrangement for Step 2. The sample is moved into the sample position for Step 3.

Step 4. Calculate the reflectivity by dividing the data, point by point, of the normalized, background-corrected reflectivity run by the data of the corrected transmission run. In some cases, data may be overdetermined; that is, the same q may correspond to more than one combination of angle and wavelength. Any differences at the same q may be due to differences in resolution or may reveal errors, which can be appraised by measuring at more than one sample angle setting. The reflectivity plateau below the critical angle should show up as $R = 1$ in the ratio of reflectivity and transmission measurements. Sometimes it is useful to carry out measurements on known samples to verify the instrument calibrations.

Step 5. Analyze the data by inverting the relationship between reflectivity in q-space and the refractive index in real space (see Eq. 5-MR1). A trial-and-error process usually is sufficient, in any case putting in as much previous knowledge of the scattering length densities and layer thicknesses as possible and least-squares testing each trial scattering

length density profile for goodness of fit. It is often necessary to make allowance for interlayer roughness and/or interdiffusion, which fuzz out the sharp interfaces between layers. Indeed this may be the object of some measurements.

The simplest result that explains all the data and prior information must be accepted—this is *Occum's Razor*, a principal that must always be applied.

References

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