

Neutron and X-ray reflectometry

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Thin film systems and surfaces of soft and hard matter are very frequently characterized by neutron and x-ray reflectometry. For this, the sample surface is illuminated with small angle of incidence and the specularly (exit angle equals incident angle) reflected beam is analyzed. The reflectivity gives information about the depth dependent density of the sample, where density is the electron density for x-rays, the scattering length density for usual neutrons or the magnetization for spin polarized neutrons. In this lecture the theory of reflectivity is introduced first in Born approximation which is very instructive. Afterwards the exact Fresnel formalism is presented. The "phase problem" and the limit of thin layers and large roughnesses are also addressed. For low contrast layer systems an advanced method to analyze reflectivities is presented. Finally, magnetic reflectivities using spin polarized neutrons are shortly explained. After the theoretical part it is shown how a reflectivity experiment works and what the experimenter has to take into account for it. Finally, several examples on different systems are presented to highlight the advantages of reflectometry when layer systems or surfaces are investigated.