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# Mechanics of buried thin polymer films revealed by a combined full analy-sis of the off-specular and specular neutron reflection

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In this work we show the power of the off-specular scattering (OSS) technique applied simultane-ously with the specular reflection (SR) to probe the thermal capillary-type wave spectrum of buried interfaces between immiscible polymer layers. The combined SR and OSS data analysis performed using a quick and robust originally developed algorithm, includes a common absolute scale normal-ization of both types of scattering, which are intrinsically linked, constraining the model to a high degree [1,2]. This, particularly, makes it possible to extract the spectral wavelength cut-offs and ampli-tudes of the interlayer roughness between the two polymers. By a systematic study of these pa-rameters as a function of polymer layer thickness in the range from nano- to sub-micrometer we show that it is possible to show deviations from Newtonian viscosity of the buried polymer layer and that viscoelastic effects have to be taken into account. By using an appropriate model suggest-ed for polymer brushes we are able to extract the shear modulus of a buried thin polymer film sup-ported on a solid substrate without applying external forces. The example presented here consists of polystyrene and polymethyl-methacrylate bi-layers annealed above the glass transition tempera-ture and then rapidly quenched to room temperature for the neutron scattering experiment.
On a wider perspective, the here presented method allows, by the use of nominally elastic scatter-ing, to access mechanical material properties of thin buried liquid films by analyzing the thermal fluctuation spectra of their surfaces.

References
[1] A. Hafner et al., J. Appl. Cryst. (2021), 54, 924.
[2] A. Hafner et al., J. Phys.: Condens. Matter (2021), 33, 364002.

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