X-ray reflection from inorganic and organic multilayers

Dick K.G. de Boer and Ann J.G. Leenaers, Philips Research Laboratories,
Prof. Holstlaan 4, 5656 AA Eindhoven, The Netherlands

Specular X-Ray Reflectometry at glancing incidence is a useful method for the analysis of layered materials with layer thicknesses in the nanometer range [1]. It enables the determination of layer thicknesses, densities, (root-mean-square) interface roughnesses and gives an indication for the presence of interfacial layers. Non-specular (i.e. diffuse) reflection measurements yields more information on the rough interfaces, viz. the lateral correlation of the roughness and their conformality [1,2]. Here we show results of specular and non-specular measurements on two kind of systems.

The first is a Ni/C multilayer which may be used as x-ray mirror [3]. We were able to distinguish the Ni-on-C from the C-on-Ni interface roughness using the x-ray standing wave structure in the non-specular measurements. Also the lateral and perpendicular correlation lengths of the roughness could be determined.

The second kind of systems are side-chain liquid-crystalline polymer films, based on alternating copolymers of maleic anhydride and alpha-olefins carrying terminal mesogenic methoxybiphenylyloxy groups. These materials show lamellar ordering upon annealing above the glass transition temperature. The structure of these nm-scale films has been investigated by atomic force microscopy and specular x-ray reflectometry [4]. Non-specular x-ray reflectivity measurements indicate high correlation lengths for the top and bottom interfaces, but small correlation lengths inside the films [5].

[1] D.K.G. de Boer, A.J.G. Leenaers and W.W. van den Hoogenhof, X-Ray Spectrom. 24 (1995) 91.
[2] D.K.G. de Boer, A.J.G. Leenaers and R.M. Wolf, J. Phys. D: Appl. Phys. 28 (1995) A227.
[3] A.J.G. Leenaers, J.J.A.M. Vrakking and D.K.G. de Boer, Spectrochim. Acta B 52 (1997) 805.
[4] M.W.J. van der Wielen, M.A. Cohen Stuart, G.J. Fleer, D.K.G. de Boer, A.J.G. Leenaers, R.P. Nieuwhof, A.T.M. Marcelis, E.J.R. Sudholter, Langmuir, in press.
[5] D.K.G. de Boer, A.J.G. Leenaers, M.W.J. van der Wielen, M.A. Cohen Stuart, G.J. Fleer, R.P. Nieuwhof, A.T.M. Marcelis, E.J.R. Sudholter, Physica B, submitted.