Standing wave formed close to rectangular surface grating by the grazing-angle incidence x-rays.

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The morphology of thin films deposited on rough surfaces is of great interest, both in basic research and in materials science, particularly in the investigations concerning the growth of films and multilayers [1]. The x-ray diffraction measurements of thin polystyrene films deposited on laterally structured surfaces were investigated in the original work [1]. The experiments in [1] were performed using x-ray scattering in the region of small incidence angles to investigate the layer thickness and structures of the interfaces grating-polystyrene and polystyrene-air, as well as using the atomic force microscopy to examine directly the topmost surface. The calculations of x-ray scattering intensity were done in [1] within the Born approximation.

The x-ray intensity calculations are more correct if someone uses an equations, which describe the dynamical x-ray standing wave (XSW) fields formed very close to surface grating on dielectric substrate. The entire wave field intensity is periodical above the sample surface and is modulated along this surface (e.g. see [2]) in the case of the grazing angle incidence x-ray diffraction (GID) geometry.

We consider in this paper the x-ray GID by a rectangular periodical surface grating. The XSW in the GID case makes it possible to study more correctly the shape of thin polystyrene films deposited on laterally structured surfaces. The mathematical model corresponding to the investigated surface grating is constructed. The description of the x-ray standing wave is based on the method of construction of eigenvalues and eigenfunctions [3] for the model under investigation.