CHARACTERIZATION OF INTERLAYER CORRELATIONS IN SPECIAL PLANAR STRUCTURES BY SPECULAR NEUTRON REFLECTOMETRY

R. Nurulin[1,2], R. Safonov[1,3], M.V. Avdeev[3], V.A. Matveev[4], B. Mukhametuly[3,2]

[1] *Faculty of Physics and Technology, Al-Farabi Kazakh National University, Almaty, Kazakhstan*
[2] *Institute of Nuclear Physics, Almaty, Kazakhstan*
[3] *Joint Institute for Nuclear Research, Dubna, Russia*
[4] *Petersburg Nuclear Physics Institute named by B.P. Konstantinov of the National Research Centre «Kurchatov Institute», Gatchina, Russia*

E-mail: rasim.nurulin.99@inbox.ru

Both periodic and aperiodic structures are the basis for development of neutron optical devices, such as supermirrors [1], as well as special structures for advanced reflectometry experiments [2-4]. They consist of a system of multilayers composed as a set of bi/multilayers of materials possessing high and low optical potentials. Roughness and homogeneity control at layer interfaces is a subject of special consideration when such systems are made on extended substrates using magnetron deposition according to special algorithms. There is a general problem how to reliably characterize interlayer correlations in a multiparameter system with a greate number of inner interfaces.

In this work, we consider this problem regarding experimental possibilities of specular neutron reflectometry for periodic and aperiodic structures based on $Ni_{1-x}Mo_x$/Ti bilayers in special cases. For periodic structures with equal sublayer thickness, the observation in practice the peaks corresponding to systematic extinctions gives the direct information on the depth correlation length of the multilayered structure. Smearing effects due to inhomogeneities at the inner interfaces in aperiodic structures with equal sublayer thickness in each bilayer are modulated by the algorithm used in the deposition.

Here, the analysis is given for samples produced in NRC KI - PNPI by dc magnetron sputtering on float glass. Two series of periodic and aperiodic (linier growth thickness growth) multilayered structures based on $Ni_{0.9}Mo_{0.1}$/Ti bilayers were prepared for NR experiments in the specular mode. The NiMo alloy was used to avoid magnetic scattering of neutrons. Measurements were done at the neutron reflectometer GRAINS with a horizontal sample geometry at the IBR-2 reactor, FLNP JINR.

The experiment aimed at testing the application of specular neutron reflectometry for characterizing the quality of a model system (e.g. neutron supermirror) imitating aperiodic structure in a step-by-step manner regarding several deposition stages.

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