Ni/Ti multilayer supermirrors for neutron optics

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Ni/Ti multilayer supermirror is a kind of depth-graded multilayer, which provides higher critical reflective angles (θ_c^{SM}) increase by m times as large as the total critical reflective angle of nature nickel bulk (θ_c^{Ni}). So, the neutron optical device based on multilayer supermirror can obtain higher neutron flux than one based on Ni single-layer mirror. The fist neutron supermirror was developed by Mezei. By now, neutron supermirrors have been used in many kinds of neutron optical devices, such as guide tubers, benders, collimators, polarizers. In this report, the Ni/Ti neutron supermirrors with m=2.0 were design by the method developed by Hayter and Mook for wavelength of 0.47nm neutrons, and the layer thicknesses were shown in Fig. 1. Then, the Ni/Ti multilayer was fabricated by direct current magnetron sputtering, on 180mm×70mm float glass substrate. The reflectivity of Ni/Ti supermirror at wavelength of 0.47nm neutron was measured by V14 neutron beam line at BENSC, Germany. The measured curves were shown in Fig. 2, comparing with the design curve. The measurement suggests that the critical angle of the supermirrors were 2 times that of bulk Ni.

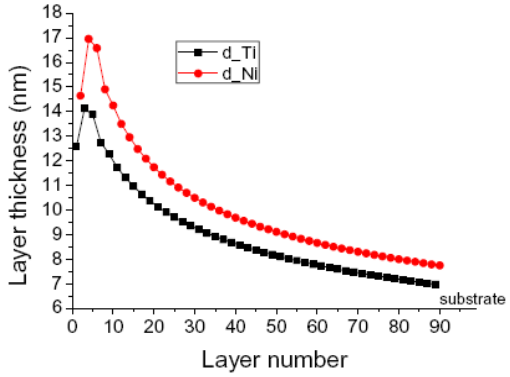

Fig. 1. Depth-graded layer thickness distribution of Ni/Ti multilayer with layer number 90 for supermirror m=2

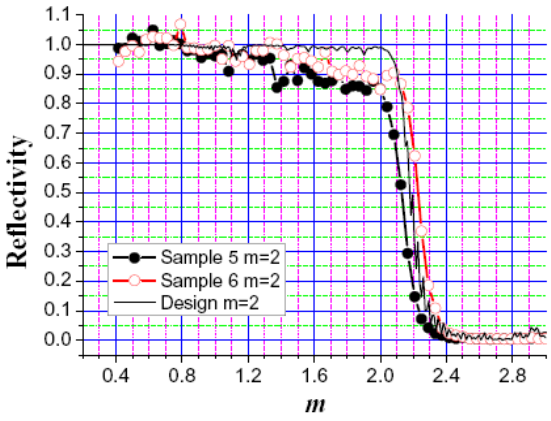

Fig. 2. The reflectivity curves measured at V14 neutron beam line at BENSC, Germany

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