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High Performance Supermirrors on Metallic Substrates

Abstract:
Recently, we have developed an optimized process for polishing Al substrates leading to an extraordinary low surface roughness comparable to float glass of high quality. Indeed, supermirror coatings with $R = 91\%$ at the critical angle of reflection of $m = 2$ were produced demonstrating the excellent quality of the Al surface. Supermirror coated Al substrates open new options for advanced neutron optical devices. As one example neutron guides can start very close from the moderator. We investigated this option by Monte-Carlo simulations for i) a conventional, curved guide and ii) an elliptic guide. In case of i) an increase of flux at long wavelengths is obtained because of complete illumination of the phase space accepted by the guide. The elliptic guide starting close to the moderator (ii) has significantly enhanced neutron transport properties since only useful neutrons are extracted and transported to the sample. As a result such a guide concept is superior in terms of flux when compared with a conventional guide system and in terms of signal to background and well defined beam focusing compared with an elliptic guide starting at a larger distance from the moderator. In particular, experiments on novel materials, which are often only available in small quantities or samples under extreme conditions will profit from neutron beams of such high quality.
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