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Effect of Barrier Layers on the Chemical Composition and Reflectivity of Multilayer Cr/Be Mirrors

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Currently, multilayer periodic mirrors are the crucial elements in X-ray optics. The search for novel materials for the manufacture of multilayer structures that would provide higher reflection coefficients has become an important research field in recent years. Cr-based mirrors can be used to obtain reflection in the short-wave range (3 – 6 nm). Such mirrors are promising for the elemental analysis of materials and can be used to create microscopes in the spectral regions of the "transparency windows" of water and carbon (2 – 5 nm), which opens up opportunities for studying carbon-containing substances and biological structures.

Interlayers formed at the interfaces as a result of diffusion, mechanical penetration of incident atoms during the manufacturing of mirrors, chemical reactions and other factors significantly reduce the theoretically expected reflectivity of the multilayer structure. To reduce the interaction between the main layers of the mirror such a method as the introduction of a barrier layer is used.

The work is focused on the investigation of multilayer X-ray mirrors based on Cr/Be with ultrathin layers. The structural features of extended interzones were explored using X-ray photoelectron spectroscopy, as well as the possibilities of influencing them by introducing barrier layers C and B_4C. In addition, the effect of the barrier layers on the reflectivity of the mirrors was analyzed. It was established:

- In the multilayer nanostructures, the chromium and beryllium layers are completely mixed to form $CrBe_2$ and $CrBe_{12}$ beryllides;
- The introduction of a barrier layer (C, B_4C) reduces the amount of the $CrBe_2$ beryllide with a simultaneous increase in the amount of $CrBe_{12}$ beryllide. In addition, chromium and beryllium carbides and chromium boride (in the case of the B_4C interlayer) are formed;
- The mirror $[C/Cr/Be]_{x180}$ demonstrates the best reflectivity.

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References

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