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POSITRON ANNIHILATION ANALYSIS OF NANOSIZED METAL COATINGS ZR/NB AFTER HE+ ION IRRADIATION

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Multilayer nanosized coatings with different crystal structures are considered as potential materials with high resistance to radiation defects, since vacancy-type defects and interstitial atoms recombine at the interfaces. Based on this concept, metals with different crystal structures (bcc, fcc and hcp) are considered for the fabrication of multilayer nanoscale coatings with high radiation resistance [1, 2].

The samples were analyzed using annihilation line Doppler broadening (DB) spectrometry using variable positron energy at the AIDA - Helmholtz Center Dresden-Rossendorf, HZDR. A monoenergetic positron beam 4 mm in diameter was used; the positron energy varied from 0.01 keV to 35 keV. Annihilation γ radiation was recorded by the HPGe detector with an energy resolution of 1.09 + 0.01 keV, interpolated for an energy of 511 keV. The obtained DB spectra were analyzed by estimating the parameters S and W of the annihilation line, as well as graphical representation of the R parameter as a function of S = f(W). The prepared samples were irradiated with He^+ ions using a PION-1M plasma ion source with a non-incandescent cathode. The energy of the accelerated ions was 25 keV. The irradiation time was chosen so as to cover a wide dose range from $3 \cdot 10^{16}$ to $3 \cdot 10^{17}$ ions/cm^2. During irradiation, the temperature of the samples did not exceed 200 °C.

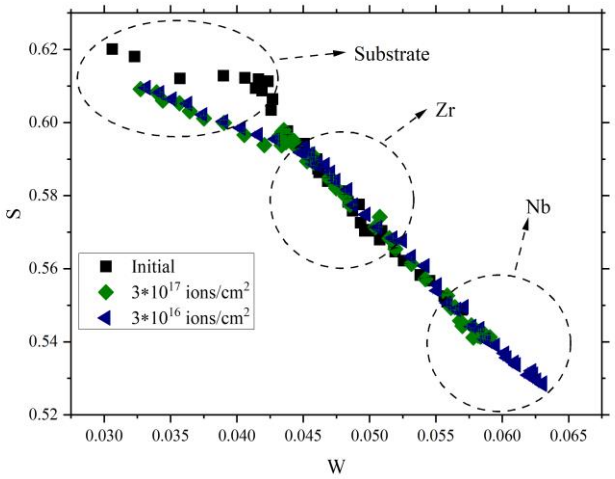

Fig. 1. Plot of the dependence of the S parameter on the W parameter for Zr/Nb NMCs with an individual layer thickness of 100 ± 10 nm and an irradiation dose range from $3 \cdot 10^{16}$ to $3 \cdot 10^{17}$ ions/cm^2

Fig. 1 shows the dependence of the S parameter on the W parameter of a Zr/Nb NMCs with a thickness of individual layers of 100 ± 10 nm and a range of irradiation doses from $3 \cdot 10^{16}$ to $3 \cdot 10^{17}$ ions/cm^2. A layer-by-layer analysis of positron annihilation in Zr/Nb NMCs showed that an increase in the dose of irradiation with He^+ ions does not lead to the formation of stable radiation defects. When the energy reaches 20 keV, the probability of positron annihilation in a single-crystal silicon substrate increases.

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REFERENCES

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