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HIGH-INTENSITY IMPLANTATION OF LOW-ENERGY ALUMINUM IONS UNDER CONDITIONS OF TITANIUM ION SPUTTERING COMPENSATION*

A.I. RYABCHIKOV, D.O. SIVIN, A.I. IVANOVA O.S. KORNEVA, D.O. VAKHRUSHEV

National Research Tomsk Polytechnic University, Tomsk, Russia

Developing the method of low-energy high-intensity implantation of gas and metal ions into various materials has shown that, in addition to the forming the ion-doped layers with thicknesses of tens and hundreds of micrometers, the new possibilities to modify the surfaces of parts have appeared. These possibilities were previously not available for traditional beam ion implantation.

This work studies the possibility to modify the inner surface of holes with focused low-energy high-intensity metal ions beams. An axially symmetric system of plasma immersion extraction and ballistic focusing ensured the ion beam formation. The impact of the ion beam on the inner surface was carried out in the beam defocusing area.

The study considered the impact of an aluminum ion beam with an average energy of 3 keV on the inner surface of a GRADE-2 titanium pipe with a diameter of 25 mm. The beams were formed from the continuous vacuum-arc discharge plasma with a repetition rate of 40 kHz and a pulse duration of 10 μs.

It has been established that the mutual sputtered material deposition on opposite sides of the hole leads to self-compensation of ion sputtering in axially symmetric holes. The ion sputtering suppression leads to an increase in the ion-doped layer thickness. As a result of ion beam impact on the inner surface of a titanium tube, there were obtained the layers containing titanium aluminide crystallites with a thickness of more than 7.5 μm with a maximum aluminum concentration of more than 25 at.%.

The impact of a high-intensity ion beam in the zone of its defocusing leads to an uneven distribution of the dopant along the length of the lateral surface of the hole. There is also a gradual decrease in the diffusion depth of implanted atoms with distance from the beam focus. The work shows the possibility of a significant improvement in the uniformity of aluminum distribution along the hole inner surface due to the reciprocating movement of the specimen relative to the focal plane of the beam.

The work considers some features of the treating the inner surface of a through and closed hole on one side of the so-called glass.

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