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STUDY OF HAFNIUM NITRIDE COATINGS PROPERTIES ON THE SURFACE OF NATURAL LEATHER

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Hafnium nitride coatings on natural leather – collagenic substrate could be used to produce orthopedic products because of its antimicrobial properties. Such plasma condensates as hafnium, inhibit the growth of the pathogenic microflora, and may be used in medicine [1].

The main material used in this research was chrome leather for artificial limbs and parts of musical instruments according to national standards. The leather contains to 16 % chemically combined and adsorbed moisture. Reduction of moisture content to 10% or less and heating to 100 °C or more leads to changes in structure of collagen. And the leather loses their shape and all properties permanently. The leather is used in the production of artificial limbs, orthopedic insoles, stump sockets and others. These products must meet the requirements of national standards. Leather material is in the contact with the human skin directly. Therefore it must meet the medical, technical and sanitary-chemical requirements, including durability, elasticity, hypoallergenic, no toxicity. The chrome leather is not fully responsible this requirements, because it contains chromium. Because of secretion of the sweat glands, chrome migrates to human skin and causes allergic reactions. Collagen is ideal place for the development of pathogenic microflora such as bacterial and microfungal infections. Antiseptics don't solve problems of toxicity and allergic reactions.

The new nanostructured coatings are known to inhibit the growth of pathogenic microflora. They are based on hafnium nitrides and condensed from the plasma phase in nitrogen atmosphere.

Cathodic arc deposition is widely used in all over the world to synthesize extremely hard film to protect the surface of cutting tools and extend their life significantly. Properties of collagen materials are fundamentally different from the properties of metals. Primarily, they have a low thermostability (up to 100 °C), high moisture content in the structure and dielectric properties. That limits the use of vacuum technology for modification of the leather and allows the use of only the elements of this technology. Before condensation the leather is kept at a pressure of 0.01 Pa. It's necessary to prevent loss of vacuum. Then the synthesis and condensation are carried out at higher pressure of nitrogen. Arc evaporator was turned on

periodically to create a low temperature condensing mode. The coating was formed on the obverse and underside of the leather by rotation in front of evaporator.

The surface topography of nitride coating on the leather with maximal condensation time is shown in figure 1. It is fundamentally different from the relief of coatings on metals. Relief of coating on the leather resembles a mountain landscape in microsizes with elements having a nominal diameter of 1-3 μm. Projections of balls with a diameter of 0.3-3 μm are dropping phase. They are formed by arc evaporation cathode metal. Large drops with diameter of 2-4 μm spontaneously fall from the surface to the bottom of the vacuum chamber. But small ones (200-300 nm in diameter) stick to the surface. Then they are overgrown nitride phase.

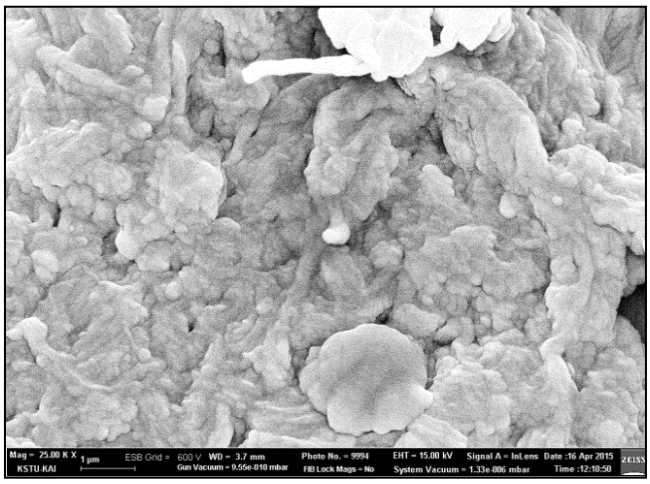

Figure 1. SEM image of the surface topography of nitride coating on the leather

It is found that the coating of hafnium nitride doesn't degrade the properties of the leather. It gives to the front surface of biocompatibility with human tissues and inhibits the growth of pathogenic microflora and microfungi [2]. The use of leather with titanium-hafnium nitride coatings is planned in the production of leather-metal prostheses of lower extremities.

REFERENCES

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