

THE FORMATION OF FILMS OF ANODIC TITANIUM OXIDE AND THEIR USE IN MAXILLOFACIAL SURGERY

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Anodic titanium oxide is widely used in electronics. The first applications of valve metal oxides, in particular titanium oxide, are associated with the manufacture of capacitor dielectrics [1]. In recent years, interest in titanium oxide has increased due to its use in the production of memristors [2] and photoelectric converters [3, 4]. In addition, such films are used in medicine as coatings for titanium implants [5-7].

In this work, we studied the process of creation of anodic titanium oxide, the optical properties of the formed films, examined the options for using such films in maxillofacial surgery, in particular for visualization and hiding of titanium objects.

In the process of research, thick anodic oxide films were formed at voltages from 10 to 200 V. The thicknesses of the formed films were determined by the Newton color shade method. It should be noted that by varying the voltage in the range from 10 to 200 V, barrier oxide films with a thickness of 30 to 300 nm can be grown. In this case, the color of the formed films covers the entire color range of the visible spectrum from violet to red.

Of particular interest are films of red, blue and green, because combining these color shades you can get any color of the visible range. It should be noted, that films of dark and flesh tones are used for staining titanium medical implants used in maxillofacial surgery.

The studied films can also be used to create anti-reflective coatings for solar cells. By setting the required reflection and transmission spectra, one can use the useful part of the solar spectrum for the generation of electric energy. Also, titanium oxide is optically active, which allows the use of this oxide to purify water and air from organic contaminants.

Titanium implants, with titanium oxide films deposited on their surface, are widely used in medicine. In particular, the processing of the titanium surface is carried out in order to control the process of bone tissue regeneration on titanium structures used in the process of surgical treatment.

It is possible to use titanium implants with painted surfaces in order to visualize and hide objects in maxillofacial surgery. Since biological tissues have different optical permeabilities depending on the structure, the painted titanium surface can be visualized by exposure to visible light, which has positive and negative sides with different methods of implantation of titanium structures. Visualization of implants is due to the different optical permeability of biological tissues and the thickness of their layer. Metal structures (osseous plates and screws) during surgical interventions for traumatic injuries of the maxillofacial region can be removed after performing their functions according to indications after 10-12 months. At the same time, the cross-tissue visualization of a titanium object painted in dark colors makes it possible to determine the exact location of the titanium implant, reduce the time of surgery and minimize surgical injury.

Titanium implants for reconstruction of the bones of the facial skeleton and contour plastic suggest a constant presence in the body. In such cases, it is necessary to ensure the visualization of the implantable mounting plates. Accordingly, it becomes necessary to use implants with a surface painted in colors close to the color of biological tissues and possessing antireflection properties. Such implants are especially useful in areas with minimal thickness of soft tissues: the orbit, the back of the nose, and the oral cavity. Depending on the location and for the purpose of devising the implantable mounting plates, preference is given to yellow, pink, beige (flesh-colored) implantations. An analysis of the data obtained during the study confirms that films of anodic titanium oxide are able to fully provide the required properties for implants, which makes the use of these films promising in maxillofacial surgery.

Thus, the studies showed that oxide films with color shades covering the entire visible range from red to violet can be formed on the titanium surface using electrochemical anodization. The thickness of the studied oxides varies from 30 to 284 nm directly proportional to the anode voltage. The formed anode oxide films can be used as antireflection coatings for solar cells, as well as for staining metal implants used in maxillofacial surgery.

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