

[54] **IMPLANTS OF TITANIUM OR A TITANIUM ALLOY FOR THE SURGICAL TREATMENT OF BONES**

[72] Inventor: Samuel Steinemenan, Liestal, Switzerland
[73] Assignee: Institute Dr. Ing. Reinhard Straumann, Waldenburg, Switzerland
[22] Filed: Aug. 27, 1969
[21] Appl. No.: 869,428

3,268,372	9/1966	Brotherton et al.....	148/20
3,338,805	9/1967	Pochily et al.....	204/56
3,346,469	10/1967	Weigel.....	204/56
3,408,236	10/1968	Hartesveldt.....	148/6.3
3,409,469	11/1968	Kuntz.....	117/231
3,442,720	5/1969	Bradley et al.....	148/6.3
3,466,669	9/1969	Flatt.....	3/1
3,508,954	4/1970	White et al.....	117/106

[30] **Foreign Application Priority Data**

Sept. 3, 1968 Switzerland13217/68

[52] U.S. Cl.128/92 D, 117/106 C, 148/6.3
[51] Int. Cl.A61f 5/04
[58] Field of Search128/92 A-92 E; 3/1; 117/106 C, 106 R, 127; 148/6.3, 6.11; 204/56

[56] **References Cited**

UNITED STATES PATENTS

2,838,430 6/1958 Argenta et al.148/20 X

Primary Examiner—Richard A. Gaudet
Assistant Examiner—J. Yasko
Attorney—McGlew and Toren

[57] **ABSTRACT**

A titanium or titanium implant with the novel feature of the surface layer formed as an oxide, nitride, carbide and carbonitride. The surface layer is applied to prevent abrasion and corrosion of the implant and to prevent fretting between contacting implants as well as to improve the appearance thereof.

2 Claims, No Drawings

IMPLANTS OF TITANIUM OR A TITANIUM ALLOY FOR THE SURGICAL TREATMENT OF BONES

BACKGROUND OF THE INVENTION

The present invention relates to an implant of titanium or an alloy based on titanium for the surgical treatment of bones. "An alloy based on titanium" is understood to be an alloy which has either a titanium content of more than 50 percent or in which at least the alloying component of the largest percentage is titanium.

Such implants are already known per se and in use. Inter alia bone plates and screws are manufactured from technically pure titanium and titanium alloys. In modern methods of surgical treatment of bones, the bone fragments are subjected to pressure when set by means of implant plates and screws and these elements are strongly dimensioned, so that the fracture does not have to be immobilized for long. Furthermore, specially shaped longitudinal slots may be provided in the plates for tensioning. Thus, when the screws are inserted into the plate and when the treated operated bones are subjected to loads, large forces occur which cause a high degree of friction between the parts and fretting of the rubbing parts. The fretting corrosion at the point of metallic contact and the whole surface of the implant effects a considerably increased amount of metal destruction with its damaging consequences.

SUMMARY OF THE INVENTION

According to the present invention there is provided an implant of titanium or an alloy based on titanium for the surgical treatment of bones comprising a surface layer from the group which includes an oxide, nitride, carbide and carbonitride. Preferably, the layer is applied to the implant by anodic treatment. Alternatively, the layer may be formed at an elevated temperature either by reaction with gases or in a salt bath. The implant surface to which the layer is applied may be polished or matt and the layer when formed may, advantageously be colored by interference.

DETAILED DESCRIPTION OF THE INVENTION

The foregoing and further features of the invention will be described with particular emphasis given to the advantages which may be attained.

The invention provides for an implant to be coated with a surface layer thereby ensuring that the surface coated implant possesses a greater resistance to abrasion than an implant

without a surface layer.

This feature of the novel implant is particularly important for those implants of titanium or titanium alloy which rub against implants which likewise consist of this metal as is the case when a screw is inserted in a compression plate. The surface coating, especially when its thickness is greater than about 0.1 μm , prevents the emergence of abrasion and also of mutual fretting because the oxides, nitrides, carbides and carbonitrides have great hardness.

5 The novel implant also possesses greater resistance to corrosion by tissue fluids, because the applied surface layers have a very low electrical conductivity not only on the parts possessing a large surface but, more important, the comparatively small depressions and apertures such as screw holes, screw slits, which are of particular sensitivity to corrosive attacks. In particular the fretting corrosion is suppressed or reduced.

10 The thickness of the surface layer of the novel implant may be chosen such that interference colors appear, the thickness for the first series of the colors gold, purple and blue being up to about 0.08 μm and repeating in a second series up to about 0.15 μm . In this case, it is possible to obtain a very exact control over the corrosion behavior in the tissues since corrosive attacks can be particularly well observed in such a layer, even if only traces are concerned.

15 It is possible to coat the implant with a layer which has a color similar to that of the tissues, such a colored implant, which frequently lies closely under the skin and may glisten through it, will no longer appear offensive, in contrast to the previously used implants having a silver or nickel color, which because of their color are often so easily visible, that they disturb the wearer.

20 Whereas, implants without a layer often show spots, which occur when the implant is handled, and which are yet intensified on sterilizing so that frequently such implants have the appearance as if the surface treatment had not been carried out properly. These disadvantages, too, are not shown by implants in accordance with this invention.

We claim:

25 1. A ductile plate implant for the external fixation of bones and having means to facilitate the fastening of said plate to the bone and being formed of titanium or an alloy based on titanium for use in the surgical treatment of bones, comprising a surface layer formed on the implant from one of the group consisting of an oxide, nitride, carbide and carbonitride.

30 2. An implant as defined in claim 1, wherein said surface layer having a thickness greater than 0.1 μ .

* * * * *

50

55

60

65

70

75