



Institut "Jožef Stefan", Ljubljana, Slovenija



center za prenos tehnologij in inovacij  
na Institutu "Jožef Stefan"

# Licensing opportunity

## A method of colouring titanium or titanium alloy

### Field of use

02002015 Surface treatment  
(painting, galvano, polishing,  
CVD, ...)

02007009 Materials Handling  
Technology (solids, fluids,  
gases)

02007015 Properties of  
Materials,

Corrosion/Degradation

03004002 Inorganic  
Substances

### Current state of technology

Stage of Development:  
Available for demonstration.

### Patent status

Patent granted in Slovenia,  
PCT filed

### Publication

TBA

### Developed by

Jožef Stefan Institute

### Reference

TBA

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### Background

A Slovenian research institute has developed a method of colouring products made from titanium or titanium alloys. These products are used in medicine (bone screws), the automotive and aerospace industry, and as décor or jewellery. Technology is more biocompatible and environmentally friendly in comparison with other colouring techniques. The researchers are looking for partners for license agreement with producers of titanium products with emphasis on medical implants.

### Description of the Invention

Products made from titanium or titanium alloys are widely used in various applications. One important application addressed is in medicine. Currently many devices such as bone screws are made from titanium or titanium alloys since titanium or titanium alloys exhibit high durability and almost excellent biocompatibility. They are very biocompatible, because there is almost no interaction between products made from titanium or titanium alloys and body tissues and body liquids. Furthermore there is a low probability of inflammatory reaction upon insertion of products made from titanium or titanium alloys into human bodies.

Different applications require bone screws of different size and shapes. In current medical praxis it is important to choose the optimal pair of bone screws and nuts for fixing particular bones. It is useful, if the bone screws and nuts are marked somehow in order to choose the right pair for particular application. Marks could be made by mechanical modifications like needle inscribing but such mechanical deformations might change the biocompatibility of the products made from titanium or titanium alloys. An alternative to mechanical marking is dyeing the products made from titanium or titanium alloys with an appropriate colour. Painting or deposition of a dye is not suitable since the deposits will change the original biocompatibility of products made from titanium or titanium alloys. An alternative to painting is synthesis or deposition of an oxide film on the surface of products made from titanium or titanium alloys with most commonly used anodic oxidation. The drawback of anodic oxidation is ecological consideration. The chemical baths currently applied contain corrosive chemicals which are often poisonous and thus represent a serious ecological risk.

Slovenian researchers have developed a method with which it is possible to colour titanium or titanium alloys in different colours using an



REPUBLIC OF SLOVENIA  
MINISTRY OF EDUCATION,  
SCIENCE AND SPORT

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oscillating magnetic field. At the same time the surface properties of the products are improved: the surface is more resistive to abrasion, scratches, and it enables biocompatibility. The method utilises an oscillating magnetic field in a low-pressure oxygen-containing atmosphere to initiate titanium oxidation. The oxide layer produced by this invention is thick enough to obtain chosen colour through interferometric effects. Colours range from yellow with the thinnest oxide layer, through to purple, blue, gold, violet, green to grey. The process does not involve deposition of different coatings nor anodic oxidation.

The invention is most suitable for colouring of medical implants of titanium or titanium alloys. Nevertheless it can be used for colouring of other titanium products, including automotive (exhaust system for motorcycles) and aerospace parts, décor and jewellery. Slovenian researchers are interested in licencing patented method to industry or SMEs, which are looking for environmentally friendly colouring technology of titanium and titanium alloys with improved biocompatibility.

#### **Main Advantages**

- the surface is more resistive to abrasion, scratches,
- it enables biocompatibility,
- colour range: from yellow with the thinnest oxide layer, through to purple, blue, gold, violet, green to grey,
- does not involve deposition of different coatings nor anodic oxidation, which can cause material to be non-biocompatible,
- can be used for various application, including for decorative purposes, labelling, protecting the surfaces made of titanium or titanium alloys, and increasing the biocompatibility.

#### **Type and Role of Partner Sought**

- Manufacturers of titanium and titanium alloy products are sought. In more detail, manufacturers of:
  - medical implants and surgical instrumentation (bone screws, nuts, etc)
  - automotive and aerospace parts (in particular exhaust system for motorcycles)
  - décor or jewellery
- Slovenian research institute has patented the technology and seeks for suitable industrial partner to license the technology.

#### **Type of Partnership Considered**

- License agreement