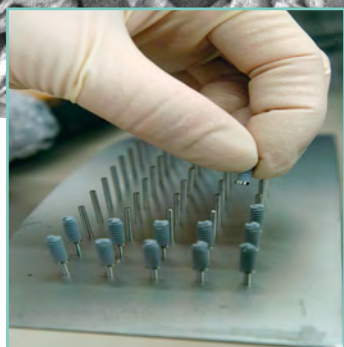
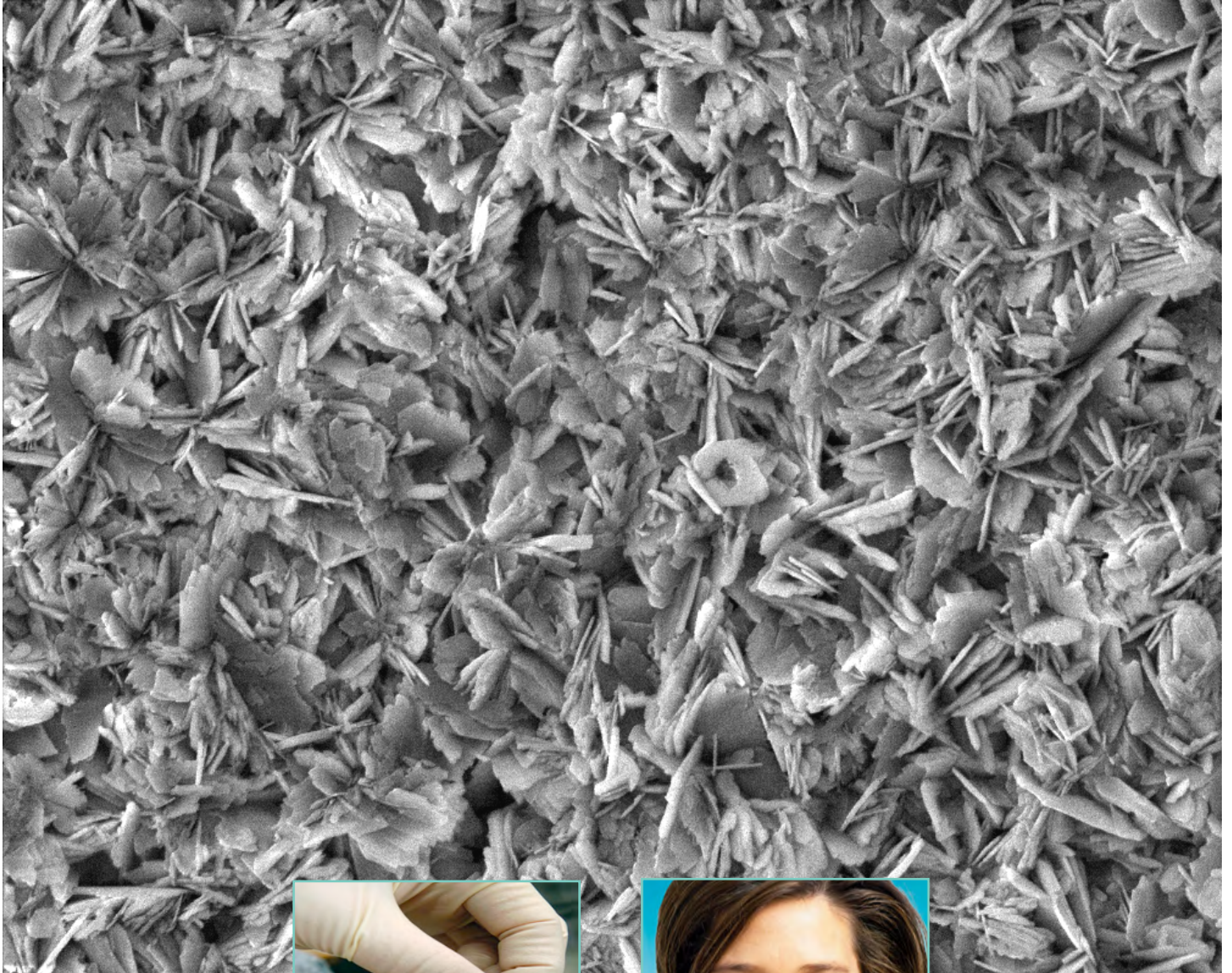


# Innovative Surface Treatments for Dental Implants



# One Source – Multiple Solutions

## Background



The long-term success of dental implants largely depends on rapid healing with safe integration into the jaw bone. Both requirements can be achieved by adequate surface functionalisation with different and complementary surface treatment processes. As a general rule, in a first step the surface is roughened by different blasting media. Where required it is further structured by an acid etching process, which is followed by the deposition of a bioactive Calciumphosphate coating. Such micro and nanostructured surfaces display a high degree of biocompatibility and promote the ongrowth of bone.

DOT offers State-of-the-Art surface treatment solutions for dental implants in first grade quality. Generally DOT surface enhancements can be supplied for all dental implant systems, independent of individual geometry. Dental implants with functional DOT surface treatments have received CE and KFDA approvals.

DOT has provided surface treatments for more than 250.000 dental implants during the past years.

Apart from the functional surface treatments for dental implants, DOT offers solutions for the anodisation of implant components and implant related instruments. Also, DOT is servicing PVD coatings for cosmetic applications and for wear reduction of rotating dental instruments.

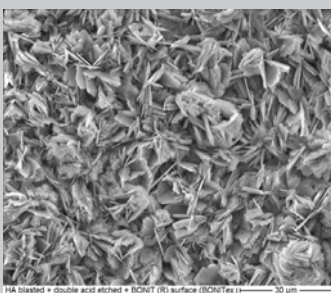
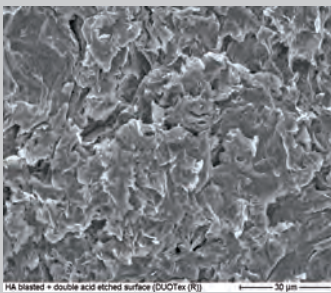
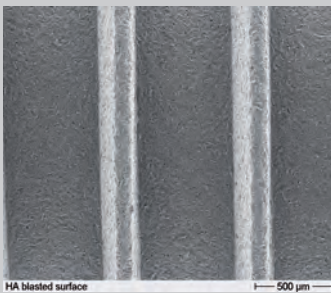
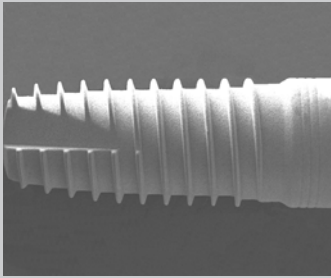
In a time where the combined application of several surface treatments becomes a key success factor for dental implant systems, OEMs can substantially benefit from a supplier, who is servicing the whole range of surface treatments. As the "one" source offering multiple surface enhancement options, DOT helps to cut production lead time and thus to speed up time to market.

DOT offers the following combined or single surface treatments for dental implant systems and instruments:

| Surface Treatment Process |                                            |                                   |
|---------------------------|--------------------------------------------|-----------------------------------|
| 1                         | Corundum blasting                          | CaP coating (BONIT <sup>®</sup> ) |
| 2                         | HA blasting                                | CaP coating (BONIT <sup>®</sup> ) |
| 3                         | DUOTex <sup>®</sup>                        |                                   |
|                           | HA blasting                                | Double acid etching               |
| 4                         | BONITex <sup>®</sup>                       |                                   |
|                           | HA blasting                                | Double acid etching               |
| 5                         | PVD coating (TiN, ZrN)                     |                                   |
| 6                         | Anodisation type II (DOTIZE <sup>®</sup> ) |                                   |
| 7                         | Anodisation type III (Colouring)           |                                   |

## Characteristics

DOT surface treatment options for dental implants (SEM pictures)



### 1. Corundum blasting / CaP coating (BONIT®)

- Generally cells adhere better onto rough surfaces. Corundum blasting creates deep pits in the surface that can act as retentive pockets for newly formed bone.
- BONIT® is an electrochemically deposited CaP coating developed by DOT. The fluid-phase coating process allows for the realisation of thin coatings with a thickness of either  $5\pm 3\ \mu\text{m}$  or  $20\pm 10\ \mu\text{m}$ . BONIT® is a composite of Brushite and HA, usually with a ratio of 95%/5%. If required, it can also be offered as pure HA coating (BONIT®-

HA). Besides the low layer thickness that prevents delamination, BONIT® has several other advantages over plasma sprayed HA coatings, such as a microcrystalline structure and homogeneous solubility. Between 6 and 12 weeks after implantation the coating is completely resorbed.

DOT has provided BONIT® surface treatments for more than 250.000 dental implants during the past years.

### 2. HA blasting / CaP coating (BONIT®)

- As a resorbable blasting media (RBM), sintered HA powder particles are increasingly used to enhance the surface roughness. The solubility of HA facilitates the complete removal of blasting residuals and ensures a clean surface. On the other hand, potential HA residuals are highly

biocompatible and therefore - contrary to corundum - cannot reduce cell proliferation and thus negatively influence osseointegration.

- CaP coating (BONIT®), see No. 1

### 3. HA blasting / Double acid etching (DUOTex®)

- HA blasting, see No. 2
- Surfaces with a high macro roughness (as generated by HA blasting), that are enhanced by a micro rough topography, have an optimal bone/implant contact.

Therefore, after HA blasting a double acid-etching step (for cleaning and texturing) is applied to add micro structure to the HA blasted products and thus to achieve optimal roughness properties.

### 4. HA blasting / Double acid etching / CaP coating (BONITex®)

- HA blasting, see No. 2
- Double acid etching, see No. 3
- CaP coating BONIT® with thickness  $5\pm 3\ \mu\text{m}$ , see No. 1

The BONITex® coating as a combination of optimal roughness characteristics and a very thin, quickly resorbable CaP layer comprises all features to allow

for high primary stability and rapid bone ongrowth. BONITex® coated implants have shown significantly increased bone-implant contact 14 to 30 days after implantation. We consider this as the "Golden Standard" for functional dental implant coatings, resulting in reduced healing time and the possibility of early implant loading.

## 5. PVD coating (TiN, ZrN)

PVD (Physical Vapour Deposition) coatings, such as Titanium Nitride or Zirconium Nitride are applied for cosmetic reasons on dental implant collars and abutments or for reasons of wear protection on rotating

dental instruments. TiN ceramic hard coatings with a thickness of ~2 µm enhance the product life span of instruments and can avoid potential contaminations due to their proven biocompatibility.

## 6. Anodisation type II (DOTIZE®)

Anodisation type II surface treatments with a thickness of max. 3 µm are produced by an electro-chemical process on prosthetic screws with the aim to reduce cold welding

and allow for easy screw removal, if necessary. The DOTIZE® procedure conforms to the standard AMS 2488.

## 7. Anodisation type III (Colouring)

To have optimal working conditions during surgical procedures, anodisation type III electro-chemically treated surfaces are used for the colour coding of dental implant abutments or temporary implant components,

such as cover screws. Depending upon the selected colour the layer thickness is 20-200 nm. DOT services a broad variety of colours.



### Publications (Selection)

1. S. Szmukler-Moncler, P. Zeggel, D. Perrin, J.-P. Bernard, H.-G. Neumann, Bio-Implant Interface 2003, 73-100, „From Microroughness to Resorbable Bioactive Coatings”
2. R. Lutz, S. Srour, P. Kessler, E. Nkenke, K.A. Schlegel, Implants 2008 (1), 16-20, „Animal experimental study of the healing of endosteal implants with vacuum titanium spray and calcium phosphate coating”

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DOT is one of Europe's leading providers of medical coating solutions for orthopedic and dental implants and instruments and also their cleanroom packaging.

We also manufacture implants and products for regenerative medicine for dental and orthopedic applications.

Our comprehensive supply chain concept makes us an ideal medical technology partner. Our activities help restore the health of patients worldwide and thus make a major contribution to the improvement of their quality of life.