



**UNIKLINIK  
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**Zentrum für  
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Kieferheilkunde**

Klinik und Poliklinik für Mund-, Kiefer-, und  
Plastische Gesichtschirurgie und Interdisziplinäre  
Poliklinik für Orale Chirurgie und Implantologie

## **Implant Study 2011/2012**

### ***Quantitative and qualitative element-analysis of implant-surfaces by SEM***

**SEM Images and EDX-Analysis**

**Medical Instinct**

**BoneTrust plus**

**LOT 605898**

In cooperation with the European Association  
of Dental Implantologists BDIZ-EDI  
Quality & Research Committee



Project manager:  
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## Background and Aim

Implant surfaces are modified by microstructures and surface extension to improve osseointegration. Numerous studies showed an increased adhesion and osteoblastic matrix-production on retentive titanium surfaces.

In 2008 we performed a scanning electron microscopic study and analyzed the surfaces of 23 enossal Titanium implants of several manufacturers at the Interdisciplinary Outpatient Department for Oral Surgery and Implantology, Department for Craniomaxillofacial and Plastic Surgery, University Cologne<sup>1</sup>.

The tested implants showed selected and / or laminary deposits. Depending on manufacturing process, accumulations of organic material (carbon) or inorganic material like aluminum, silicon, phosphor, sulfur, chlorine, potassium and calcium were found. 2011-2012 we performed the same protocol on 57 dental implants from different manufacturers.

The aim of this study was to present topographic effects of the different manufacturing processes and to analyze potential impurities.

## Material and method / study protocol

### SEM-examination of implant surface (SEM-method)

Scanning electron microscopy (SEM) enables the topical evaluation of the implant surfaces. The Inlense-Detector is located inside the electron column of the microscope and is arranged rotationally symmetric around the optical axis. In particular at low voltages and small working distances, images with high contrast can be obtained. Besides information about morphology and surface topography, the Inlense-Detector images differences in the work function (e.g., electronic variations) on the sample with high lateral resolution and allows drawing conclusions about the chemical nature and allocation of different remnants or contaminations in the sample material.

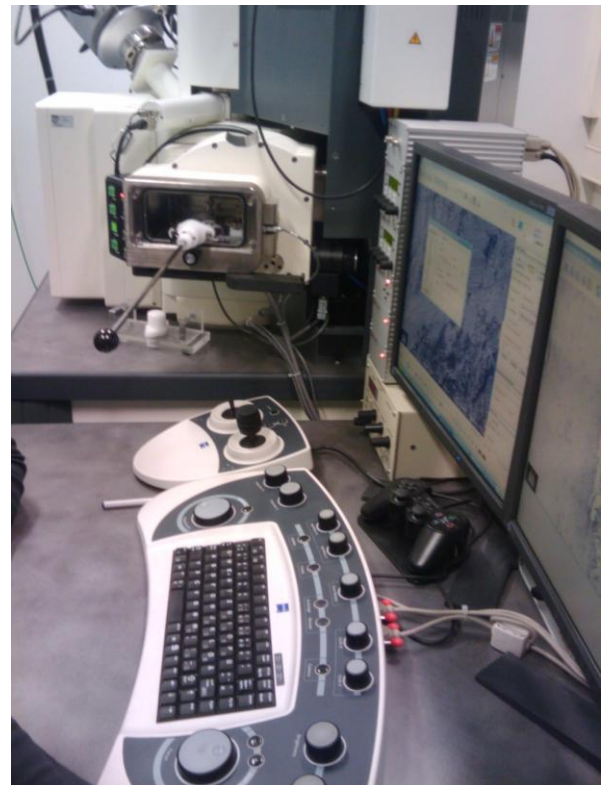
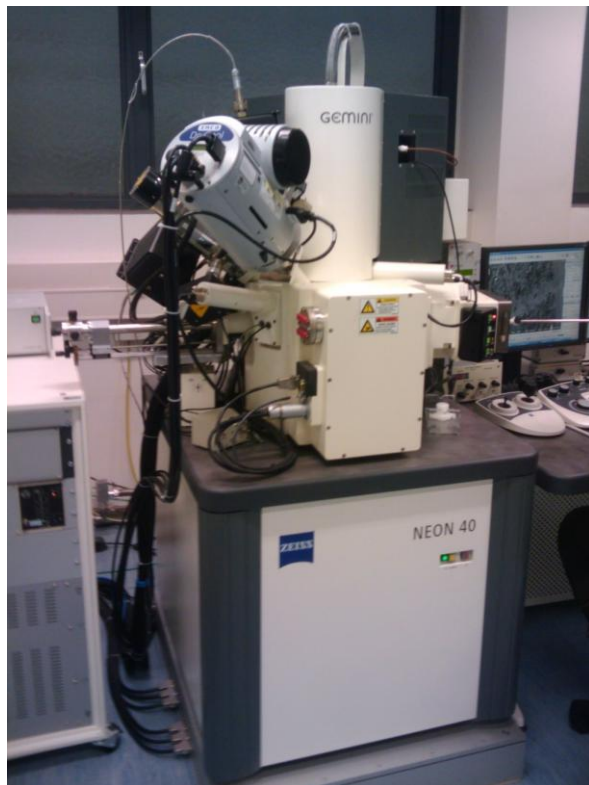
### Qualitative and quantitative analysis of implant surfaces (EDX)

Energy Dispersive X-ray (EDX) was used for the appropriate elemental analysis. Each element emits specific X-ray peaks. An area-analysis and one or more spot analyses are performed for each tested implant (analysis of spots and areas by EDX). An area analysis covers the entire implant area lying in the focus of the microscope. For a spot analysis, the electron beam is focused on a specific area to get information about selective accumulations on the implant surface.

1) Duddeck, D., Oberflächenuntersuchung von Implantaten mit dem Rasterelektronenmikroskop, Dissertationsschrift, 2009

## Scientific workstation and test procedure

Without touching the surface, implants were taken with sterile forceps out of the package and fixed onto the sample holder. Before closing the chamber, implants were blown off with nitrogen in order to remove material artifacts as dust. The so induced nitrogen peak in the following EDX-analysis was excluded by analysis-software. Afterwards the vacuum was generated and imaging as well as measuring was done.



Zeiss Surface Scanning Electron Microscope with GEMINI® Column

## Results

Compared to the preceding study of 2008 a variety of implants in the current study showed significant improvements regarding residues of blasting material (i.e. Bego, Camlog).

**The implant provided by Medical Instinct showed no significant traces of inorganic or organic residues**

## SYNOPSIS

Name of Company:	Medical Instinct
Name of analyzed Product:	BoneTrust plus Screw implant LOT 605898 Ø 4.0 / L 14,5 mm
Title of Study:	Quantitative and qualitative element-analysis of implant-surfaces by SEM
Investigators:	Dirk U. Duddeck DDS.
Study centre:	Interdisciplinary Outpatient Dep. for Oral Surgery and Implantology, Dep. for Craniomaxillofacial and Plastic Surgery, University of Cologne
Studied period:	January 1, 2011 - May 30, 2012
Methodology:	Zeiss Surface Scanning Electron Microscope with GEMINI® Column equipped with two detectors for secondary electrons: in-lens detector and conventional secondary electron detector.  EDX Analysis
Summary / Conclusions:	The implant provided by medical instinct showed no significant traces of inorganic or organic residues

## COORDINATING INVESTIGATOR(S) SIGNATURE(S)

STUDY TITLE: Quantitative and qualitative element-analysis of implant-surfaces by SEM

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*I have read this report and confirm that to the best of my knowledge it accurately  
describes the conduct and results of the study.*

INVESTIGATOR: Dirk U. Duddeck

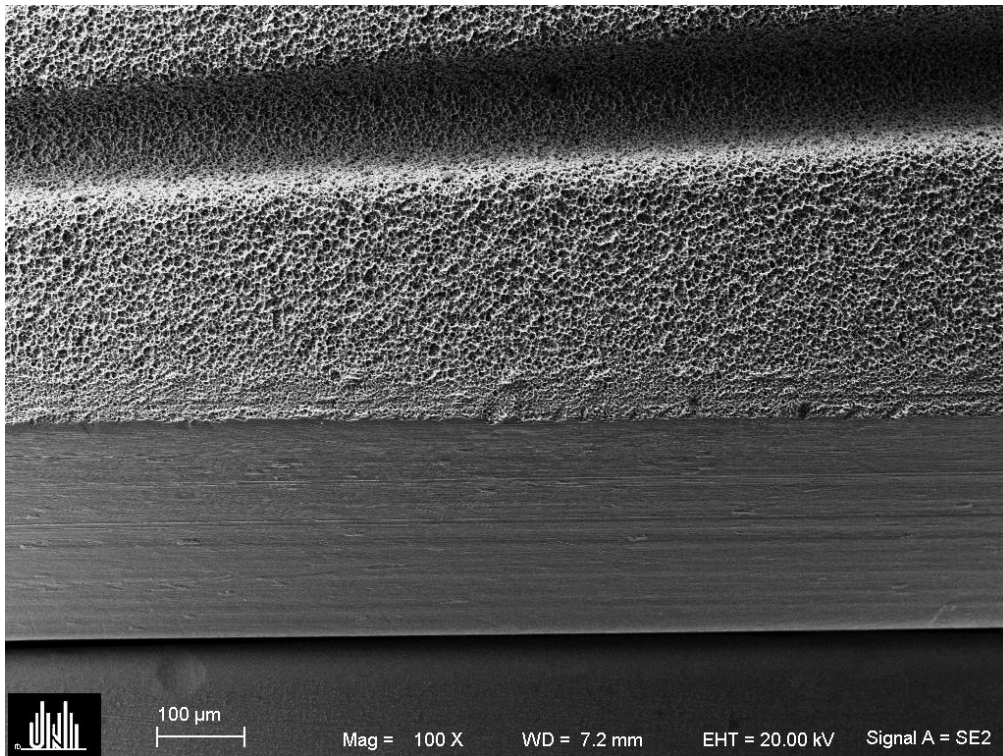


DATE: March 10<sup>th</sup> 2013

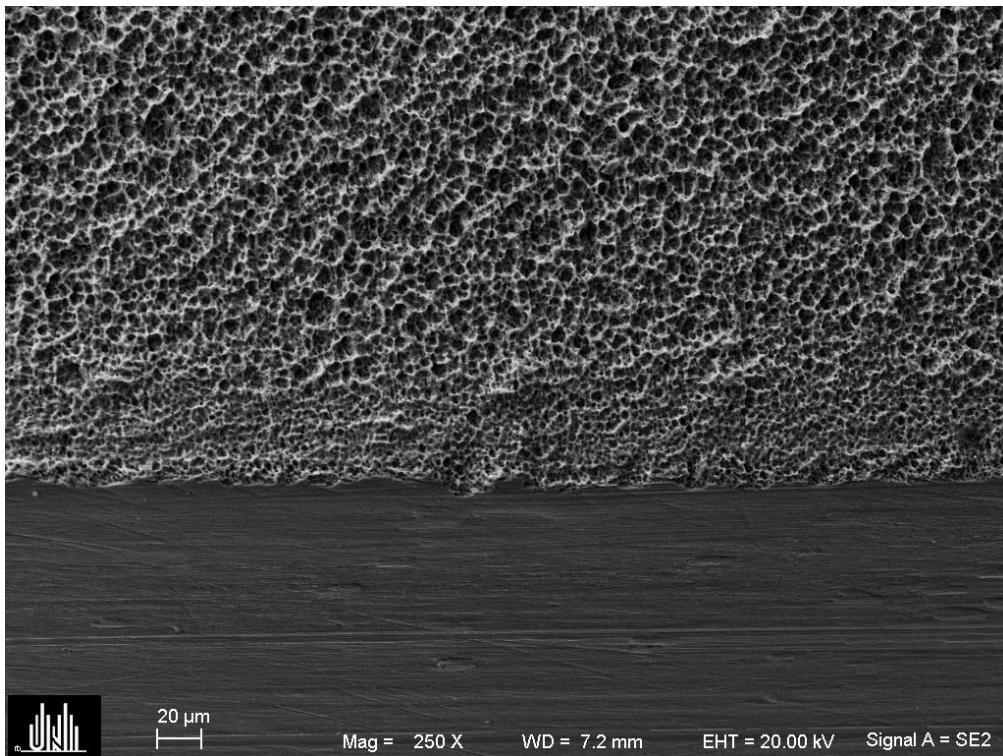
## **APPENDIX**

### **SEM IMAGES / EDX ANALYSIS**



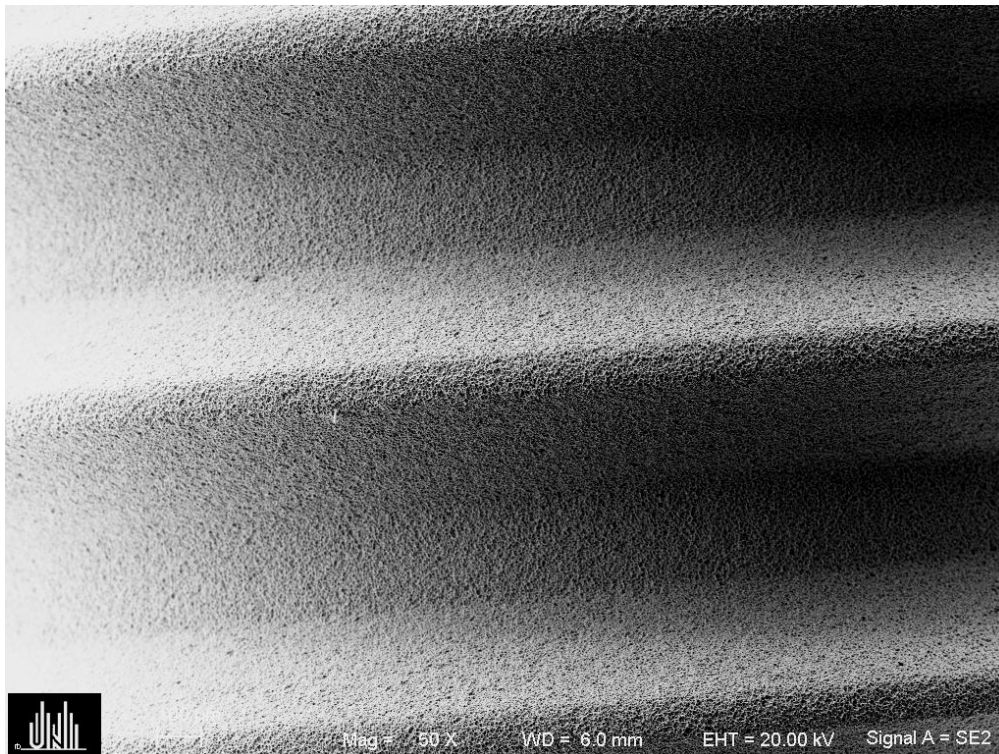


Implant shoulder SE 100x

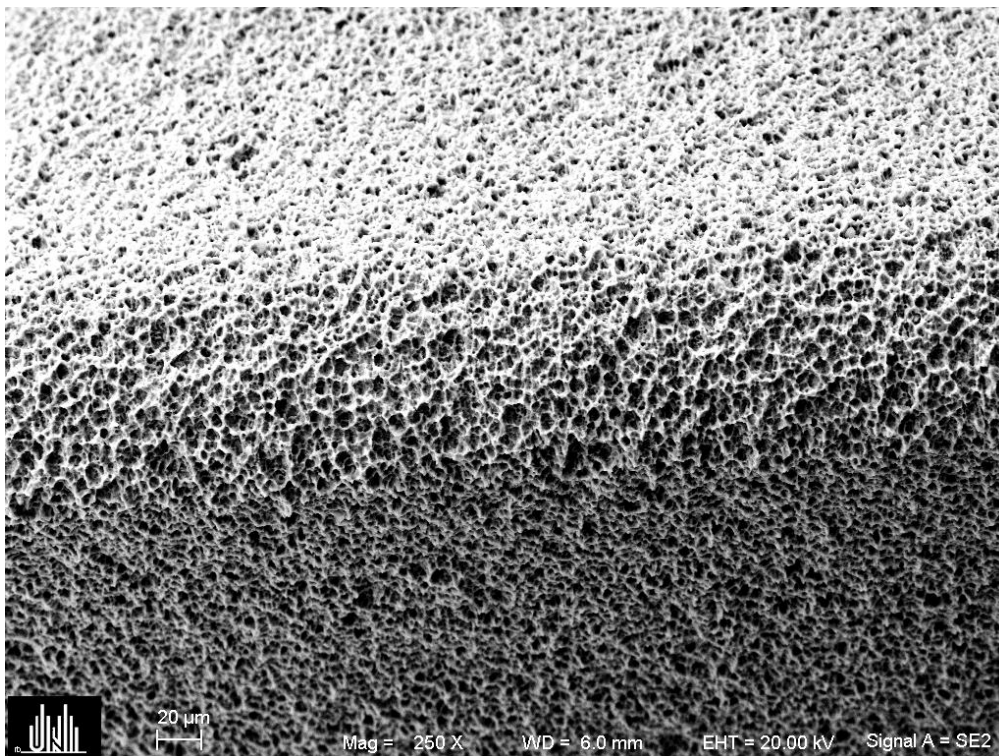


Implant shoulder SE 250x



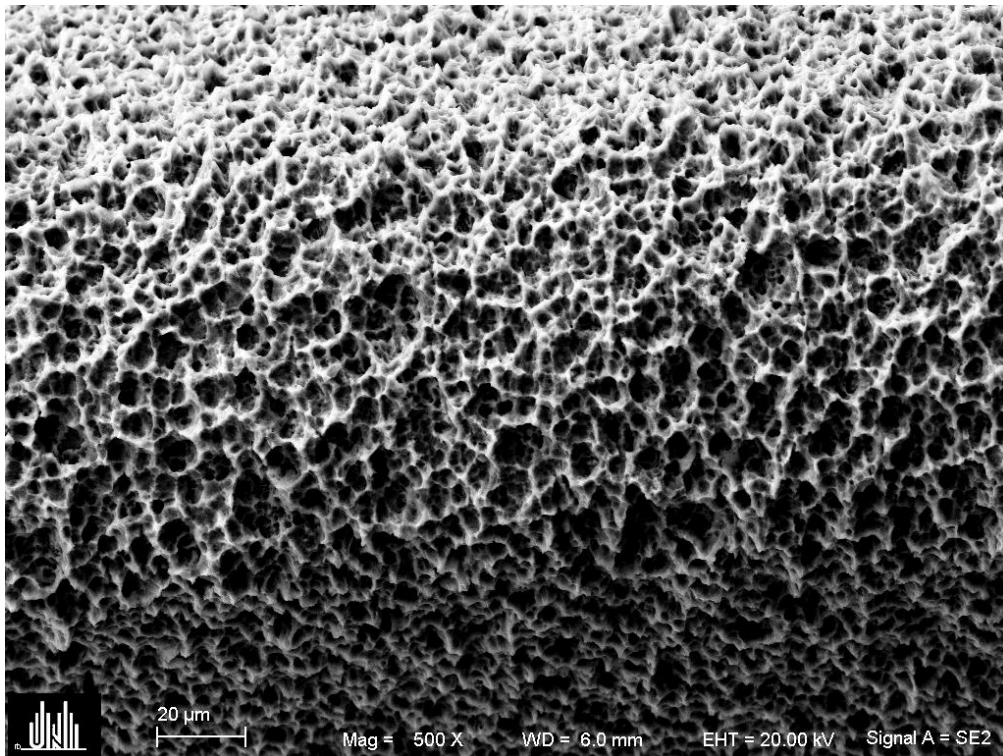


Implant surface SE 50x

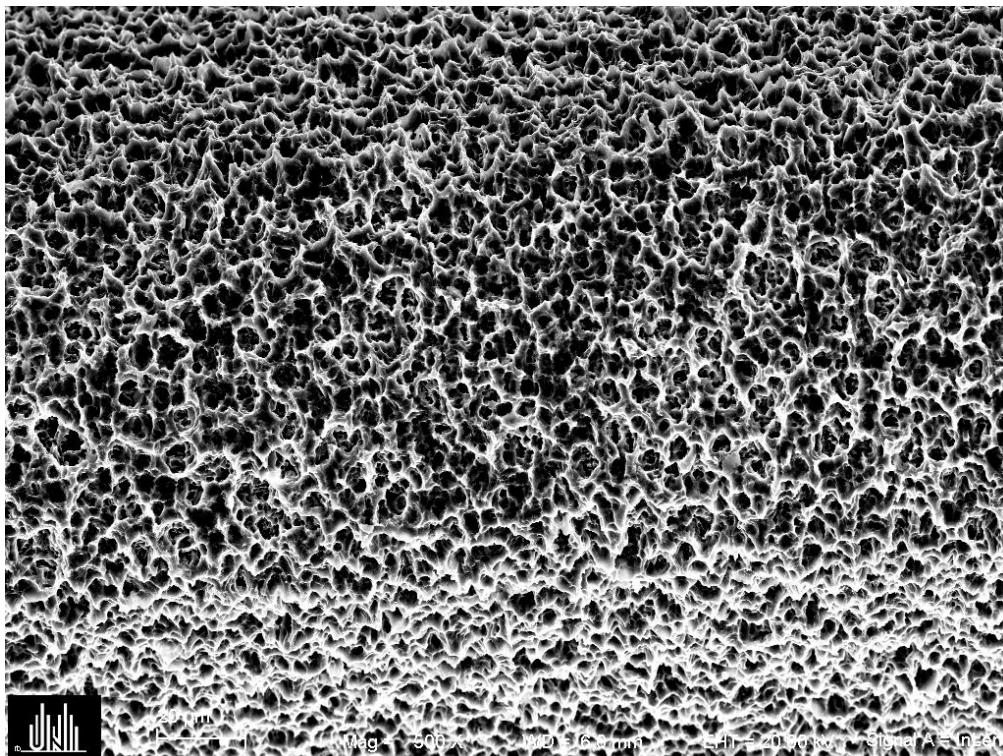


Implant surface SE 250x



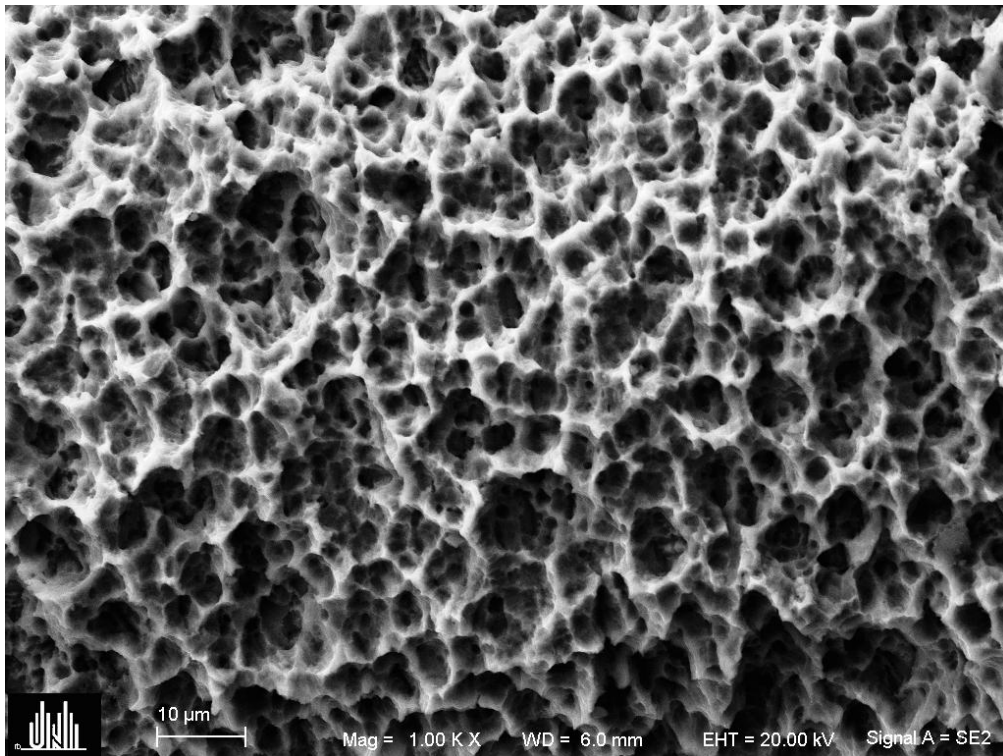


Implant surface SE 500x

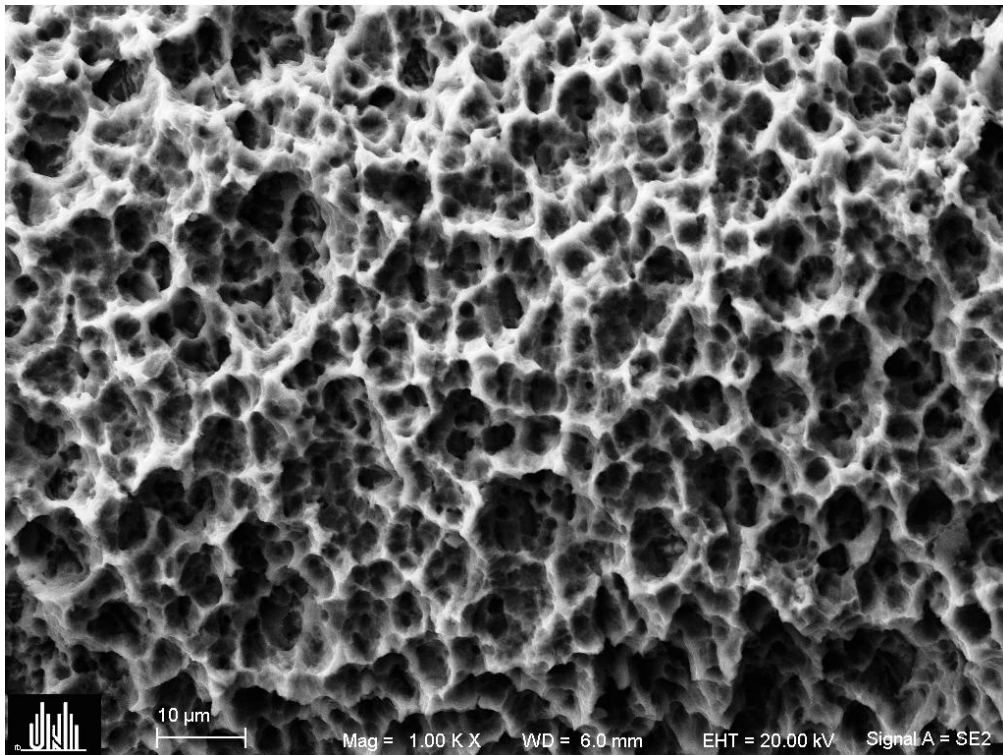


Implant surface Inlense Detector 500x

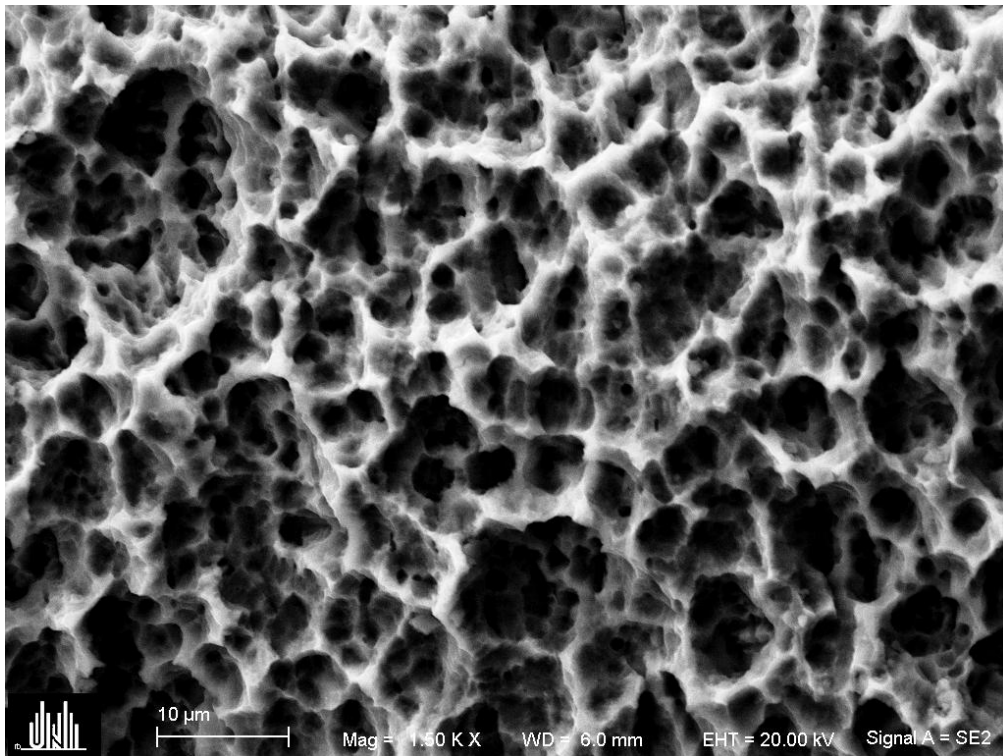




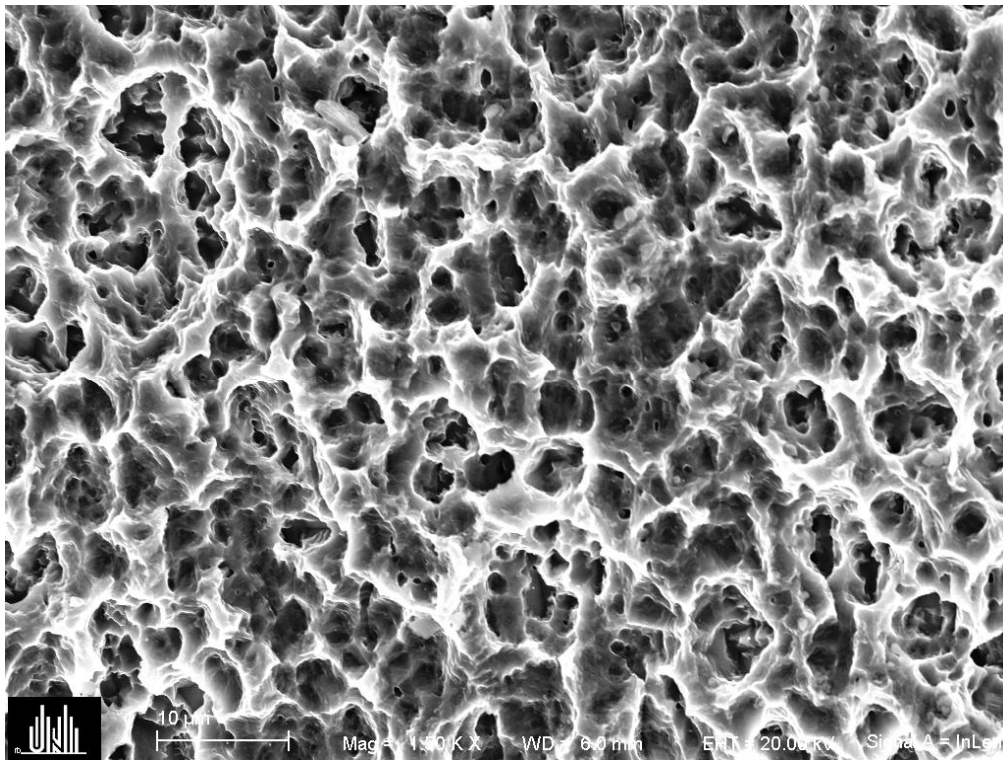
Implant surface SE 1000x



Implant surface Inlense Detector 1000x



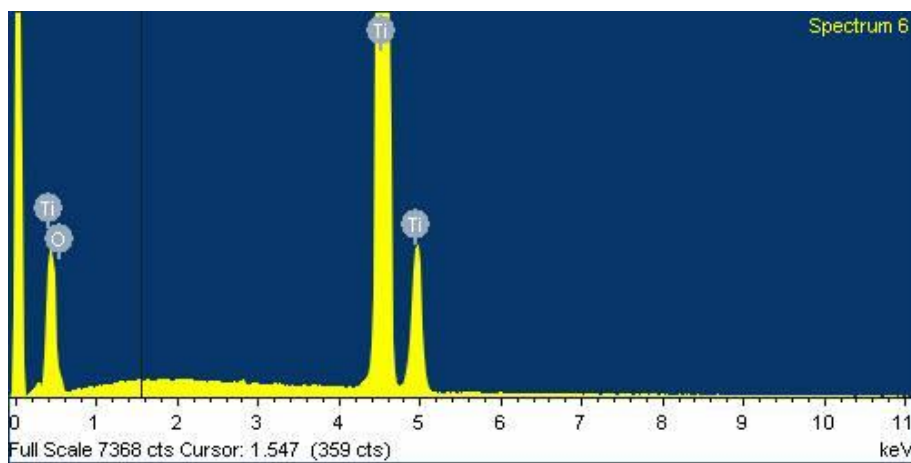
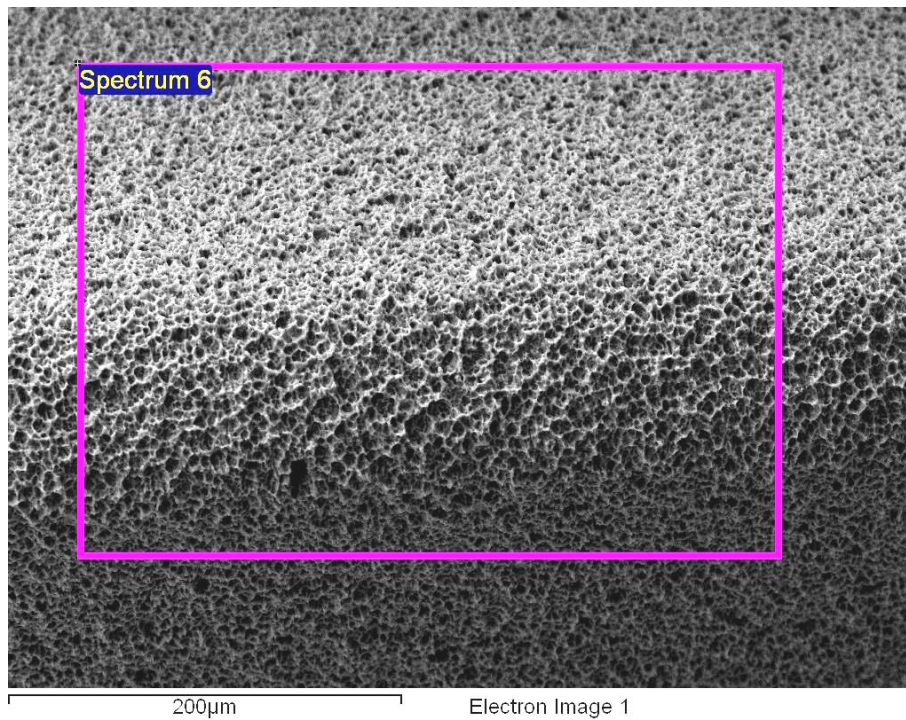
Implant surface SE 1500x



Implant surface Inlense Detector 1500x



## EDX surface analysis



Element	Weight%	Atomic%
O K	4.74	12.96
Ti K	95.26	87.04
Totals	100.00	