Invitation

to the 32nd Scientific Seminar of the Dresden Fraunhofer Cluster Nanoanalysis

We are cordially inviting you to the following scientific presentations:

“Toughening mechanisms in dentine – bioinspiration for the improvement of fracture behavior in ceramic constructs”

by Dr. Anke Märten,
Technische Universität Berlin
Institut für Werkstoffwissenschaften und –technologien

“Orientation characteristics of the materials microstructure”

by Prof. Dr. Krzysztof Sztwiertnia
Institute of Metallurgy and Materials Science Polish Academy of Sciences, Krakow

The seminar is scheduled for
Thursday, 19th December 2019, 14:00 – 16:00
at Fraunhofer IKTS, Maria-Reiche-Strasse 2, Dresden, room Einstein

We would like to invite for discussions after the seminar, with coffee and traditional Dresden Christmas Cake.

Prof. Dr. Ehrenfried Zschech
Dresden Fraunhofer Cluster Nanoanalysis

Simon Schlipf
Dresden Fraunhofer Cluster Nanoanalysis

“Toughening mechanisms in dentine – bioinspiration for the improvement of fracture behavior in ceramic constructs”

by Dr. Anke Märten,
Technische Universität Berlin
Institut für Werkstoffwissenschaften und –technologien

Abstract

Dentine is the inner part of teeth and is the softer of the two load-bearing tissues of mammalian teeth. This bony component of teeth is composed of an organic collagen fiber matrix, an inorganic calcium-phosphate salt – hydroxyapatite – and water. Unlike bone however, dentine does not remodel to repair cracks and it contains some distinct interfaces with other materials (e.g. enamel) as well as tubules that make it porous. Furthermore, it resists long-lasting cyclic loading in bacterial and acid environment. Therefore, we have to presume that there is in one hand a tolerance of cracks in dentine and in other hand there are toughening mechanisms which avoid critical crack propagation.

Although dentine has been investigated for more than 100 years, not much is known about important variations of the microstructure at the different length scales. Such information is useful for interpreting the relation between structure and properties, which is needed to understand the long-lasting endurance of these organs and also for biomimetic development of new materials.

The microstructure of different hierarchical levels in dentine and the interactions of cracking and damage with this microstructure were characterized. The gradients of properties and the arrangement of the mineral particles over large tooth sections affect the toughness and fracture behaviour of dentine. At higher length scale, the observation of crack propagation during fracture of dentine reveals differences in the strain distribution within the microstructural elements of the hierarchical levels.

Teeth are, therefore, excellent models for the development of improved ceramic constructs of zirconia. Zirconia is known as a ceramic with higher toughness due to the stress induced polymorph transformation. Nevertheless, the fracture behaviour is still brittle. Important key elements of hierarchical engineering include property gradients, interfaces and zones of varying porosity. The principal processing method showing most promise is electrophoretic deposition (EPD), while the main target property of the established ceramics is superior crack resistance and high toughness due to mechanisms that operate at different length-scales.

“Orientation characteristics of the materials microstructure”

by Prof. Dr. Krzysztof Sztwiertnia
Institute of Metallurgy and Materials Science Polish Academy of Sciences, Krakow

Abstract

Three research directions carried out in the Department of Anisotropic Structures (Institute of Metallurgy and Materials Science Polish Academy of Sciences) will be presented. These topics are linked by a research method based on orientation characteristics of the microstructure.

These research directions are:

- Novel methods for increasing mechanical properties of biodegradable zinc: Effect of multi-pass hydrostatic extrusion and alloying with magnesium.
- Microstructure, texture and mechanical properties of titanium grade 2 on complex deformation paths: Material for new dental implant designs.
- Strategy for creating bio-composites with unique mechanical properties.