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S E M I N A R
on
Semiconductor Physics and Nanotechnology

Mo, 11.12.2023, 11:15 Uhr,

Seminar in
person in the Physics lecture hall *or* via Zoom

"Bone material properties in healthy and pathological conditions"

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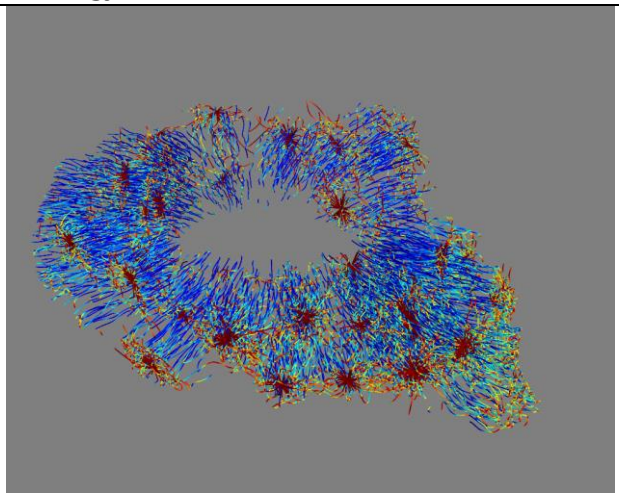

Figure: The OLCN of a human osteon, imaged with confocal microscopy of a rhodamine stained sample. Colors indicate network orientation. Canaliculi oriented towards the canal are depicted in blue, canaliculi oriented tangentially are shown in red.

Bone is a complex hierarchical structure, on the lowest level consisting of an organic collagen matrix that is reinforced by mineral particles (hydroxylapatite). I will discuss several methods that allow to analyze bone structure in a spatially resolved manner. I will show how these methods can be used to assess bone structural changes with age as well as differences between normal and pathological bone due to (rare) diseases. Micro-CT methods allow to investigate how trabecular architecture and cortical porosity change with age. In aged individuals trabecular bone volume, trabecular thickness and number are decreasing, while cortical porosity is increasing. I will explain how local mineralization with a a spatial resolution of ~1 micrometer can be assessed using quantitative backscattered electron imaging [1]. In combination with tetracycline labeling it will be shown that it is not only possible to measure the current mineralization, but also to estimate the mineralization kinetics. Mineralization kinetics are accelerated in patients suffering from osteogenesis imperfecta compared to healthy individuals [2]. Furthermore, it will be shown how the images obtained for mineralization assessment can also be used to characterize osteocyte characteristics. These measurements show that osteocyte density is decreasing with age and is higher in the cortex compared to the spongiosa [3]. Changes in the osteocyte lacuno-canalicular network (OLCN) can be obtained in full 3D by measuring the fluorescent signal in rhodamine stained samples using laser scanning confocal microscopy, highlighting changes between wildtype and knock-out mice in an animal model for osteogenesis imperfecta [4]. Local mechanical properties of bone tissue can be obtained using scanning acoustic microscopy [5]. The methods presented can also be used to assess the influence of (novel) medications on bone material properties. One example that will be

discussed, is the influence of Burosumab, a fully human monoclonal FGF23 antibody approved for treatment of x-linked hypophospatemia in adults [6].

Zoom – Link:
https://zoom.us/j/96375934537?pwd=RTlKTWhSdzRHU211YTY1bGFxTUtpZz09
Meeting-ID: 963 7593 4537
Kenncode: =r=4YQ

References

[1]M. A. Hartmann et al., “Quantitative backscattered electron imaging of bone using a thermionic or a field emission electron source”, Calcified Tissue International **109**, 190 (2021).

[2]B. M. Misof et al., “Accelerated mineralization kinetics in children with osteogenesis imperfecta type 1”, Bone **166**, 116580 (2023).

[3]S. Blouin et al., “Osteocyte lacunae in transiliac bone biopsy samples across life span”, Acta Biomaterialia **157**, 275 (2023).

[4]G. Hedjazi et al., “Alterations of bone material properties in growing Ifitm5/BRIL p.S42 knock-in mice, a new model for atypical type VI osteogenesis imperfecta”, Bone **162**, 116451 (2022).

[5]S. Blouin et al., “Cortical bone properties in the Brtl/+ mouse model of osteogenesis imperfecta as evidenced by acoustic transmission microscopy”, Journal of the Mechanical Behavior of Biomedical Materials **90**, 125 (2019).

[6]N. Fratzl-Zelman et al., “Bone Matrix Mineralization and Response to Burosumab in Adult Patients With X-Linked Hypophosphatemia: Results From the Phase 3, Single-Arm International Trial”, Journal of Bone and Mineral Research **37**, 1665 (2022).