"COST MP1301: New generation biomimetic and customized implants for bone engineering"

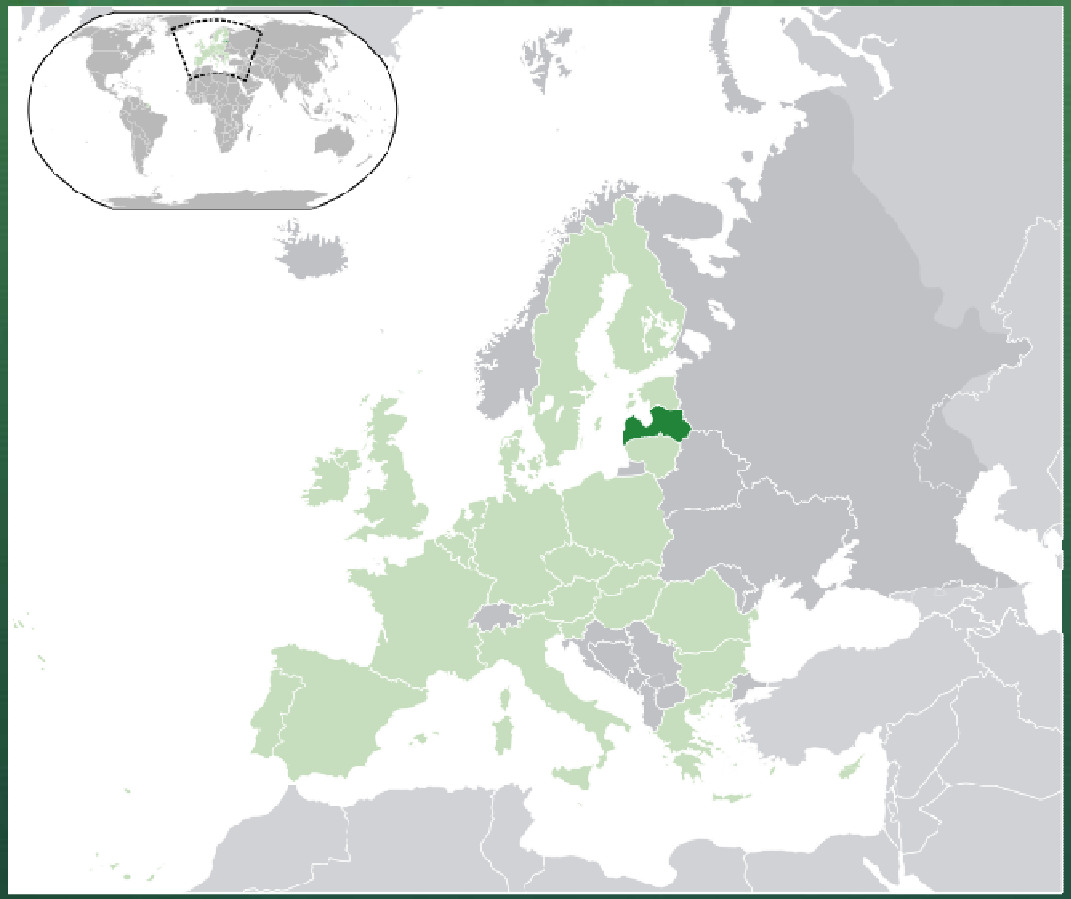
"Functionalization of biomaterials using ultrasonic technologies"

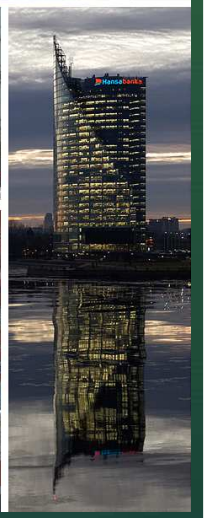
Results of the MATERA project „SONOSCA"

Dr. Janis Locs

Rudolfs Cimdins Riga Biomaterials Innovations and Development Centre of Riga Technical University, Latvia.

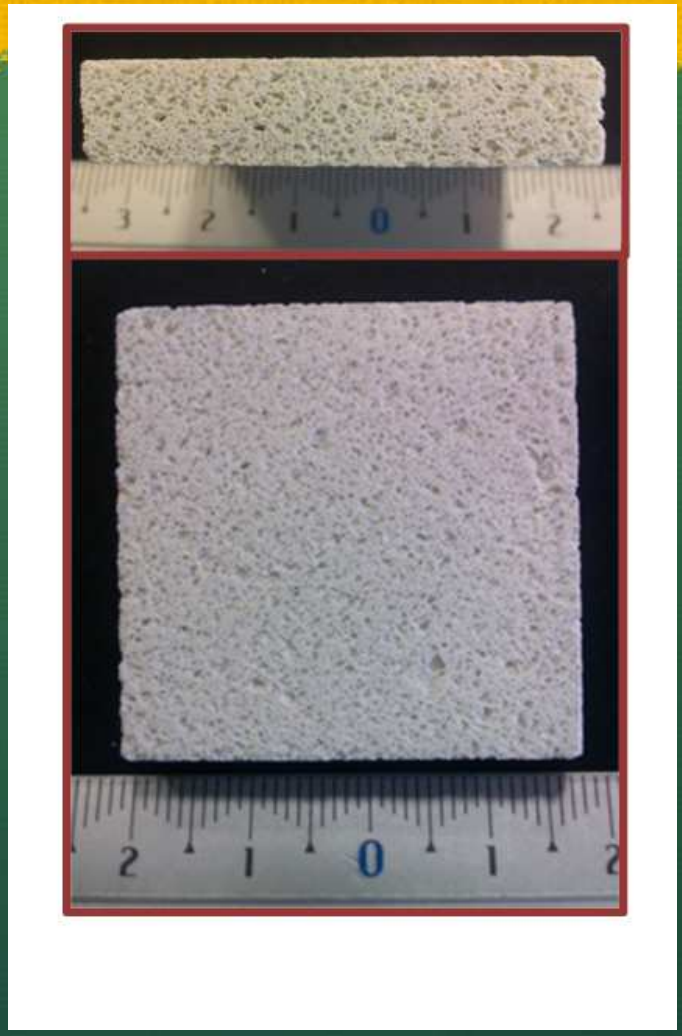
Riga, Latvia





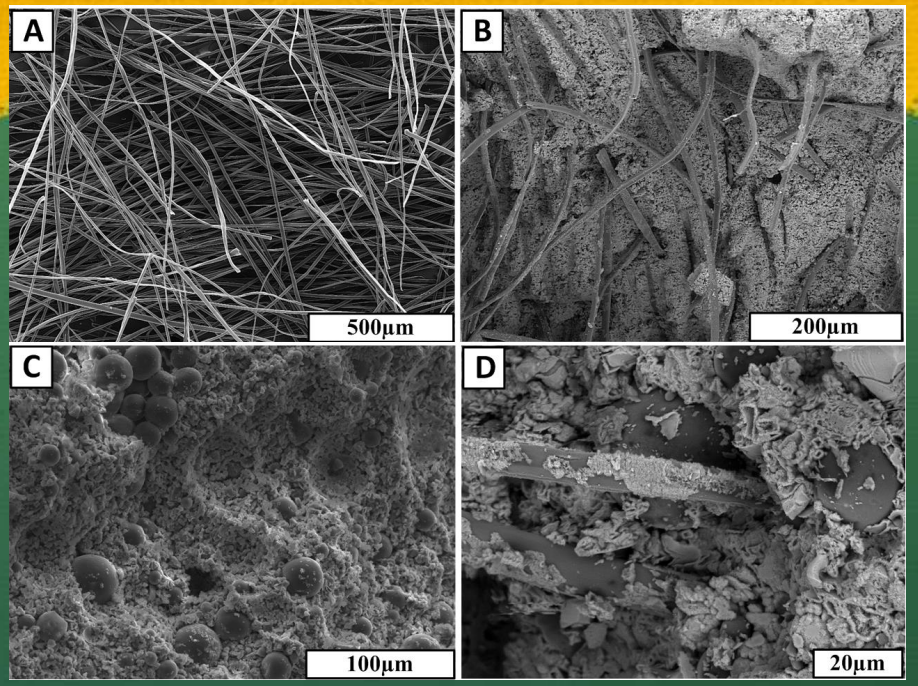
Who we are and what we do?

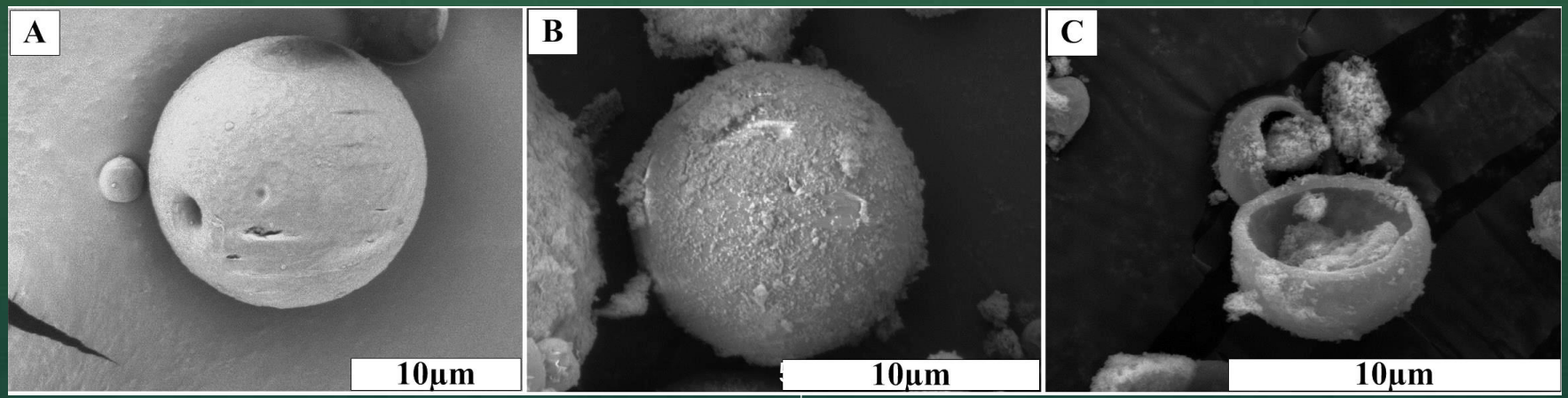
Calcium phosphate bioceramics



Other application areas

- Drug delivery systems;
- Calcium phosphate bone cements;
- Calcium phosphate – biodegradable polymer nanocomposites.





SONOSCA Partners

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Dr Ilze Salma

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RIGA TECHNICAL UNIVERSITY

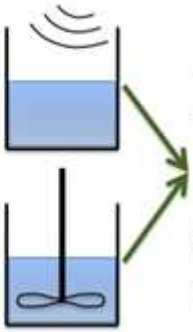
Dr Janis Locs

WP's

WP1

NPs by microwave solvotermal method

NPs by wet precipitation method

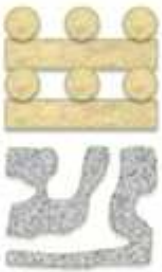


Hybrid nano-clusters

WP2

Porous bioresorbable polymer scaffold

Porous bioresorbable ceramic scaffold



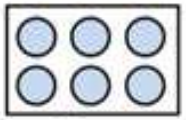
WP3

Functional coatings on the scaffolds

Hybrid NPs nanoclusters and functional coatings on the scaffolds in situ

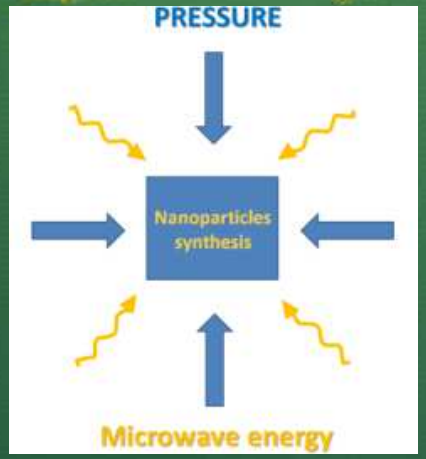
WP4

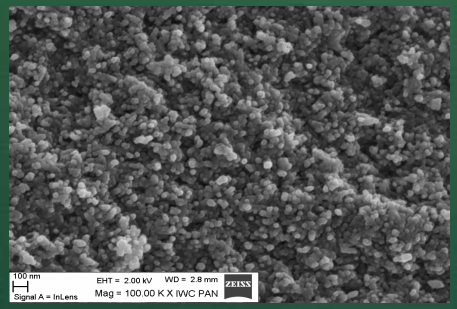
In vitro tests

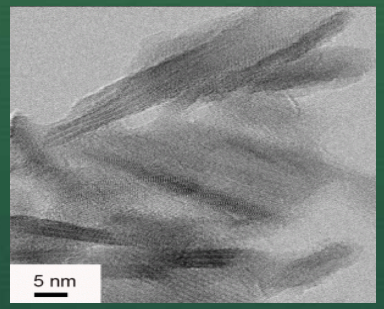


In vivo tests

Synthesis of nano-HAp







GoHAp ™ nanopowder:

- Chemical composition and hexagonal structure similar to human bone apatite;
- Nanoplates with controled size distribution (3-30 nm);
- High biocompatiblity;
- Exibits degradation behavior.

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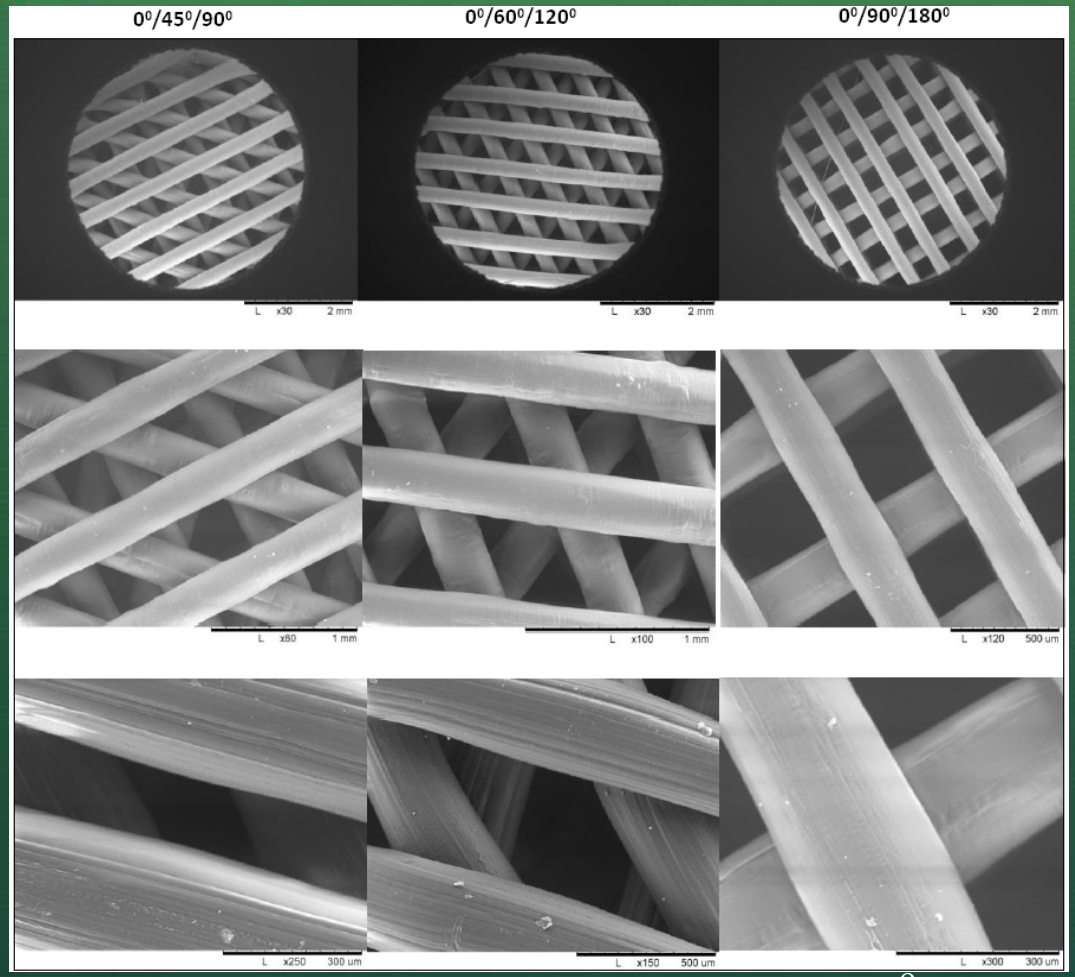
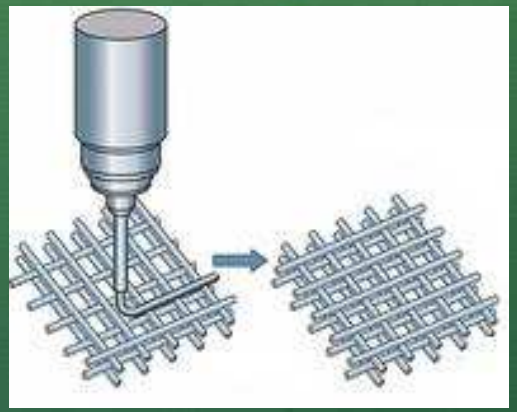
Smolen D, et al. *International Journal of Nanomedicine*. 2013;8:653-668.

Polymer scaffolds – 3D printing



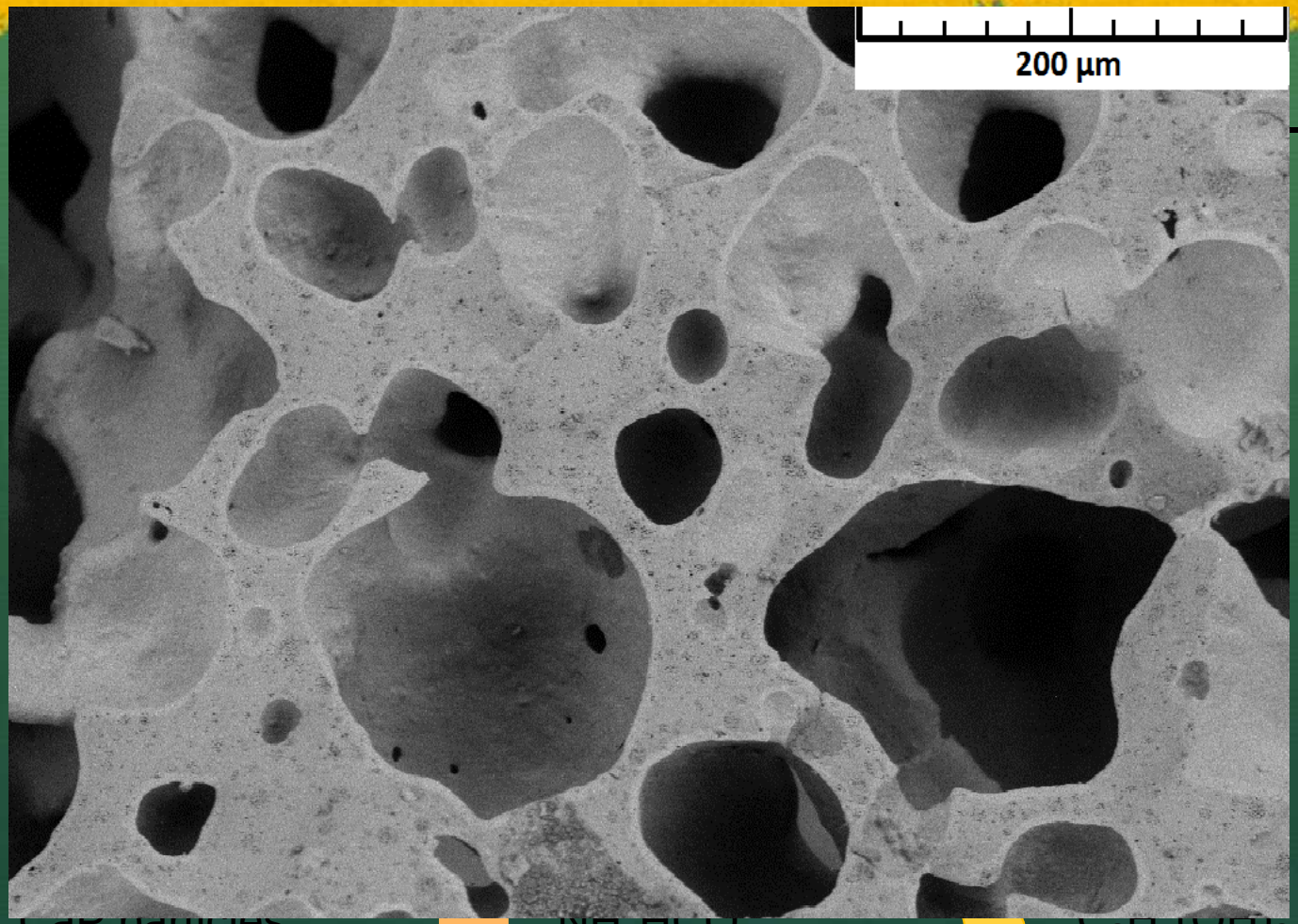


3d printing

Made by Technical University in Warsaw

Material – PCL

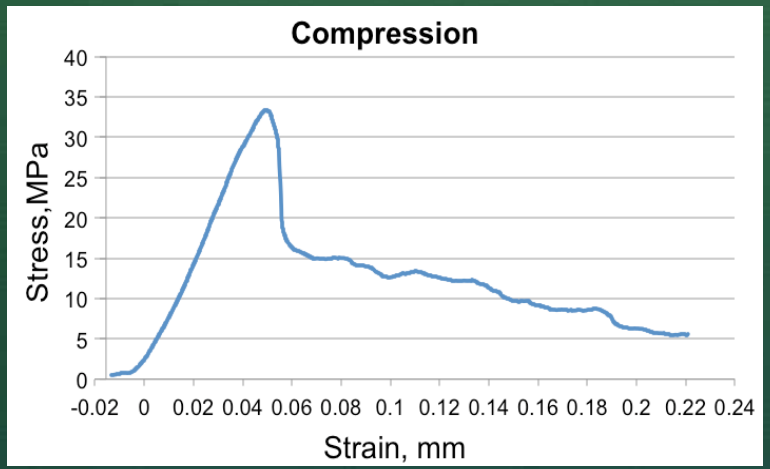
Ceramic β-TCP scaffolds

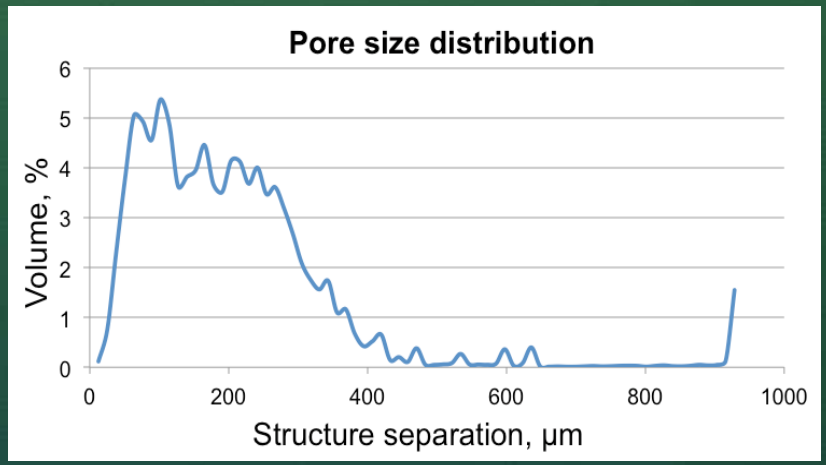


-120°C

- CaP particles
- NH_4HCO_3
- $C_3H_5(OH)_3 + H_2O$

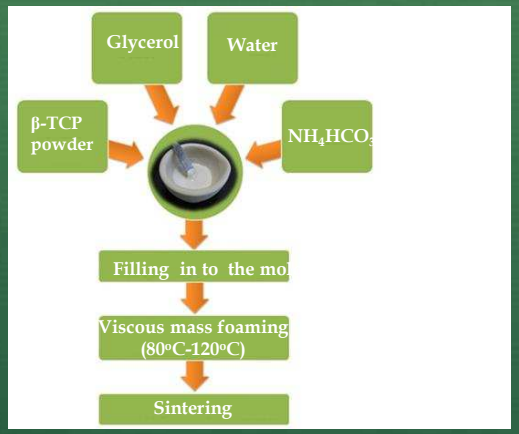
Ceramic β-TCP scaffolds

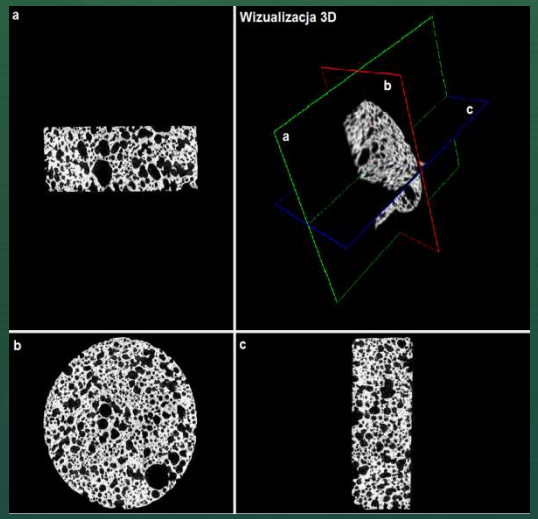




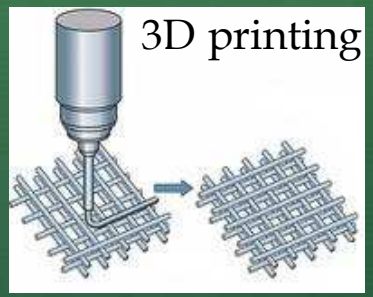
Both scaffolds with similar porosity

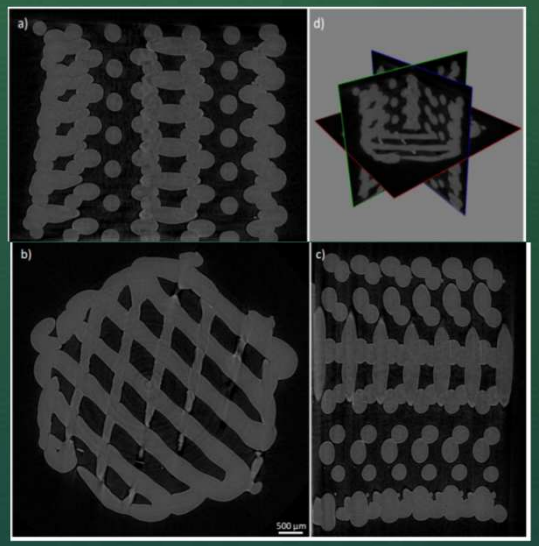
β-TCP





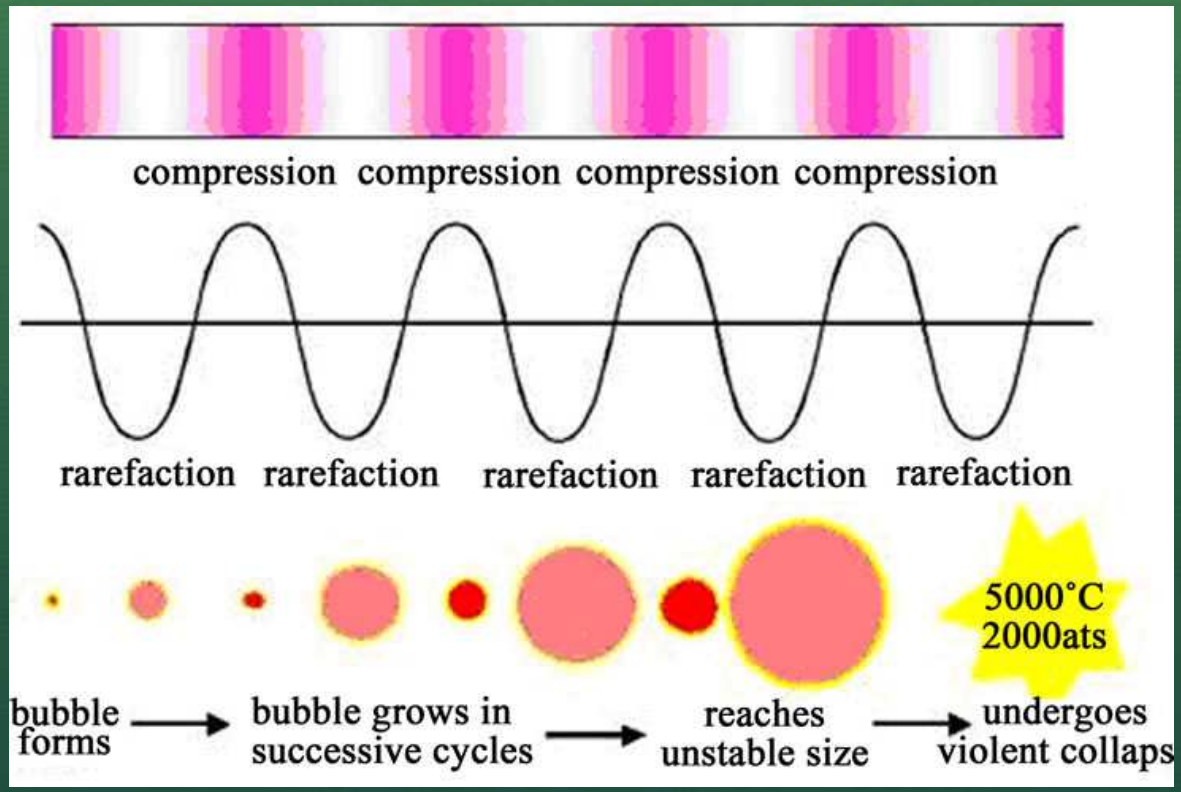
PCL (Polycaprolactone)





Functional coatings on scaffolds

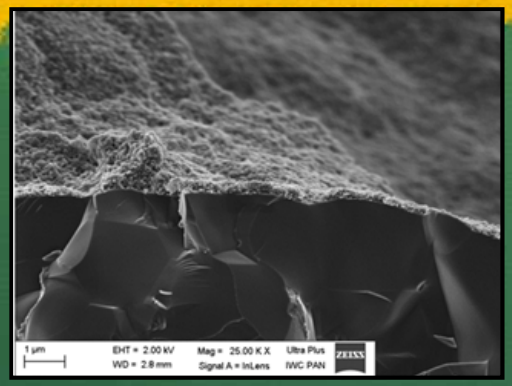
Acoustic cavitation phenomena

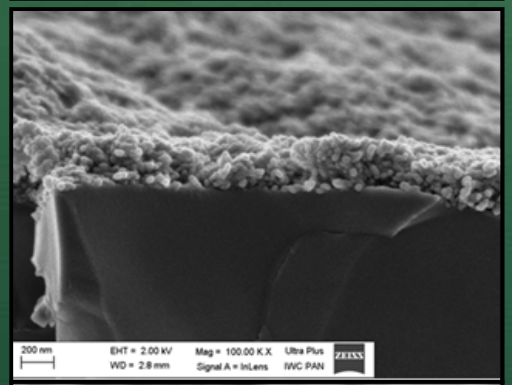


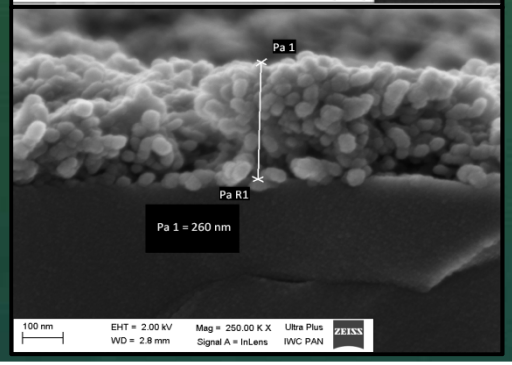
S. Sana et.al. Green and Sustainable Chemistry Vol.2 No.3(2012), Article ID:21740

Functional coatings on scaffolds

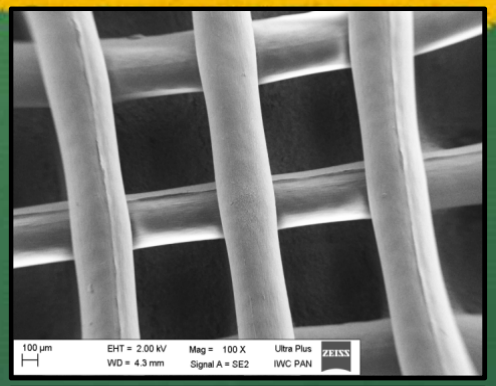
β-TCP+ GoHAP

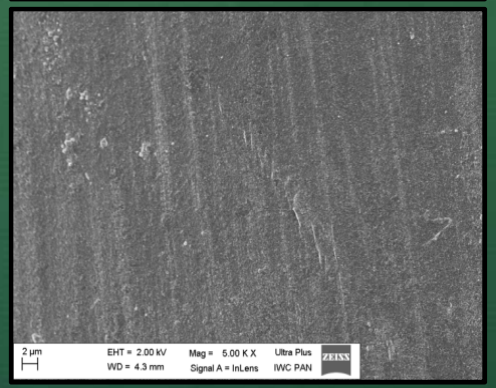


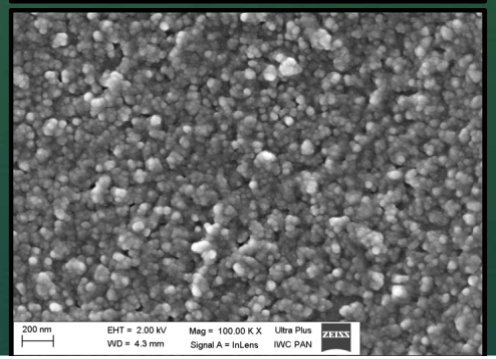




PCL+ GoHAP







In vitro tests

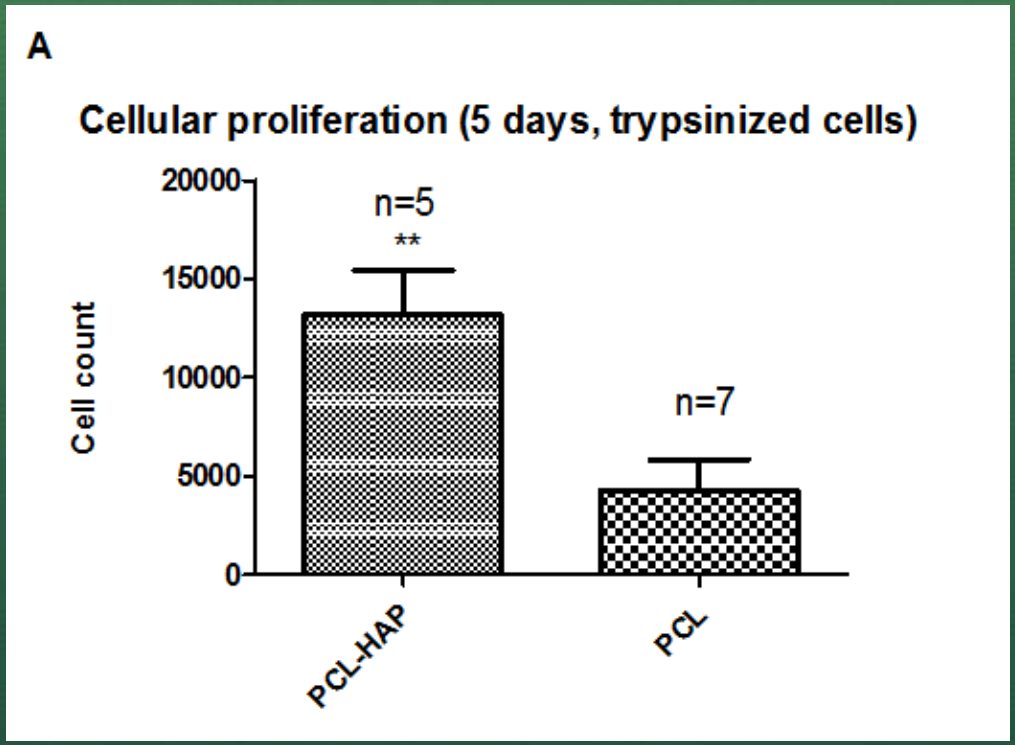


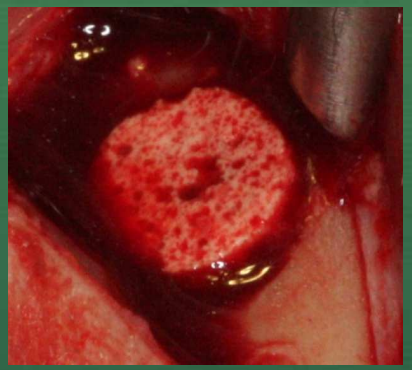
Fig. Proliferation of MG-63 cells on PCL-HAP and PCL; A – cells detached from material berofe lysis and staining

In vivo tests

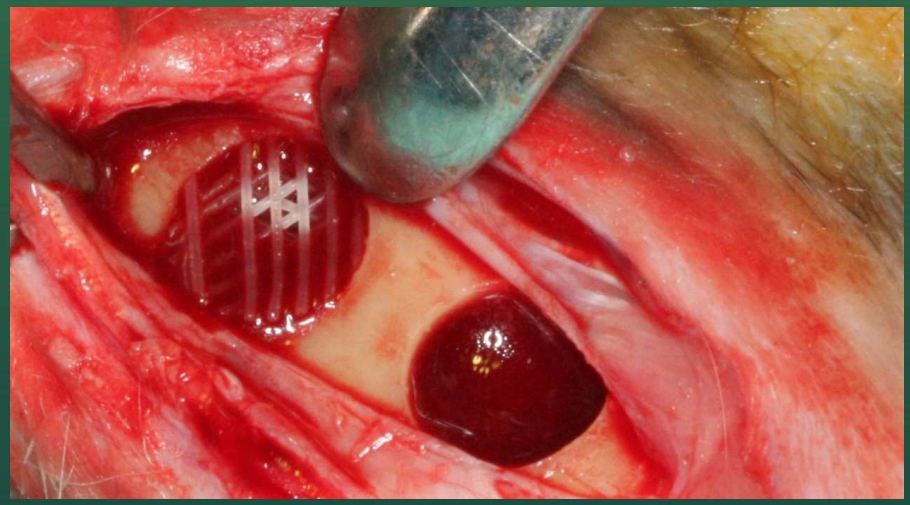
Materials were implanted in *tibia* of New Zealand rabbits

SAMPLE TYPES:

- TCP uncoated
- PCL uncoated
- PCL coated with nano hydroxyapatite
- TCP coated with nano hydroxyapatite



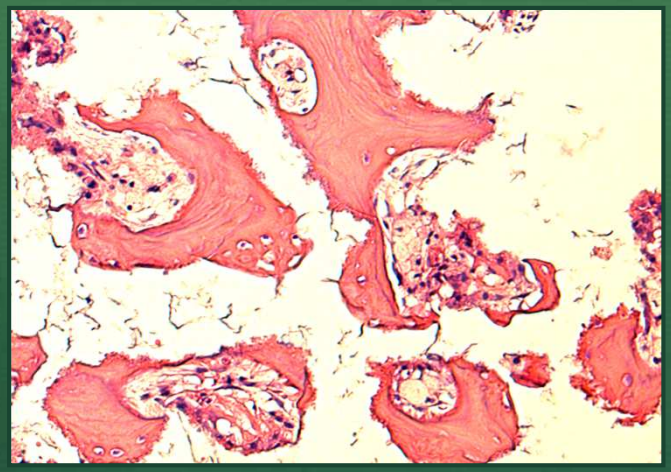
β-TCP

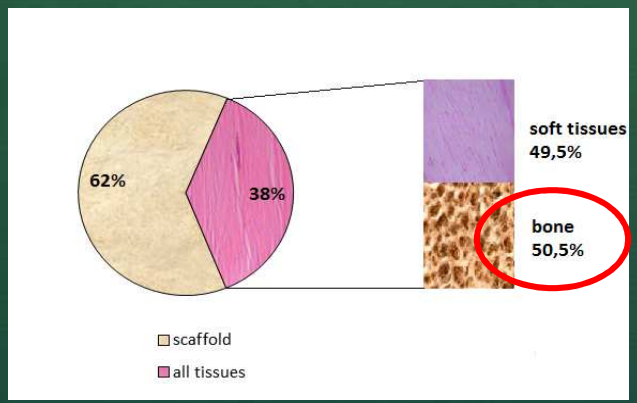


PCL

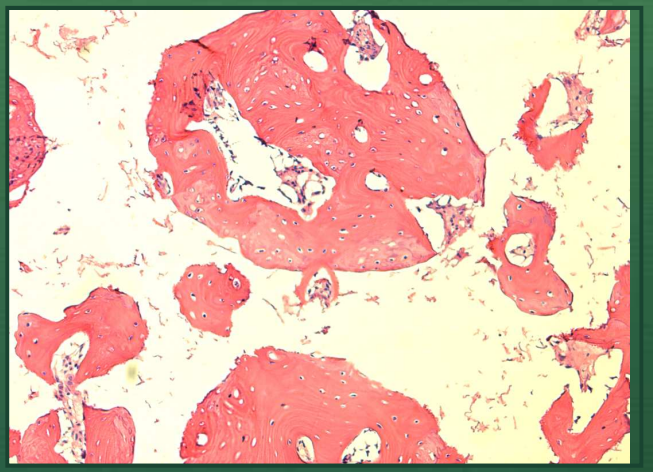
In vivo tests - ceramics

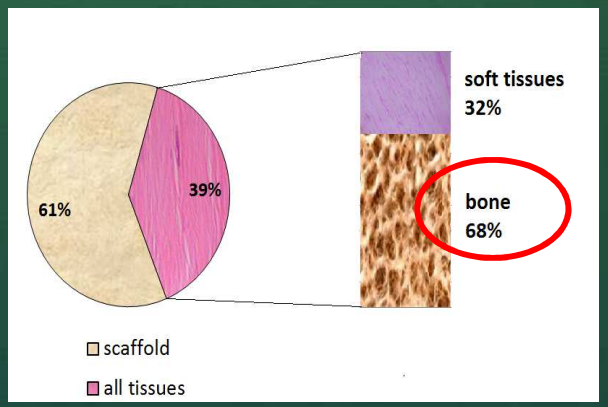
Pure β-TCP





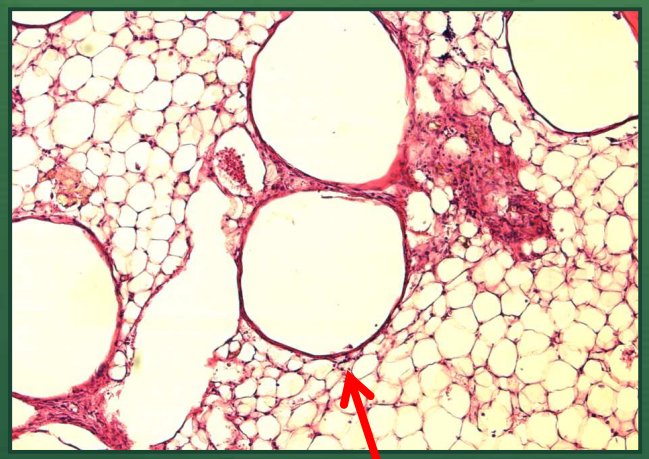
β-TCP + nanoHAP



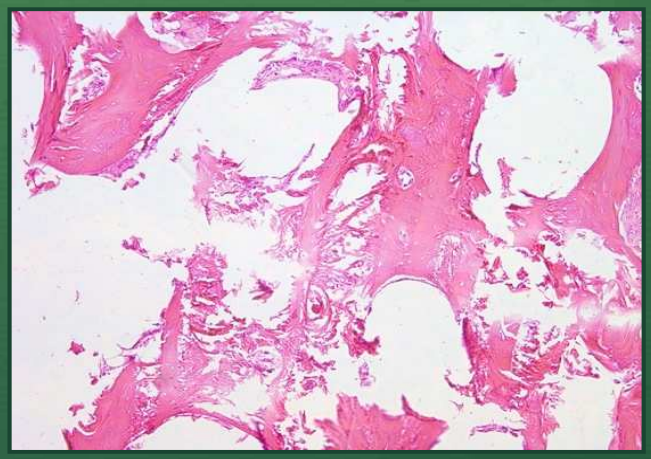


In vivo tests - polymer

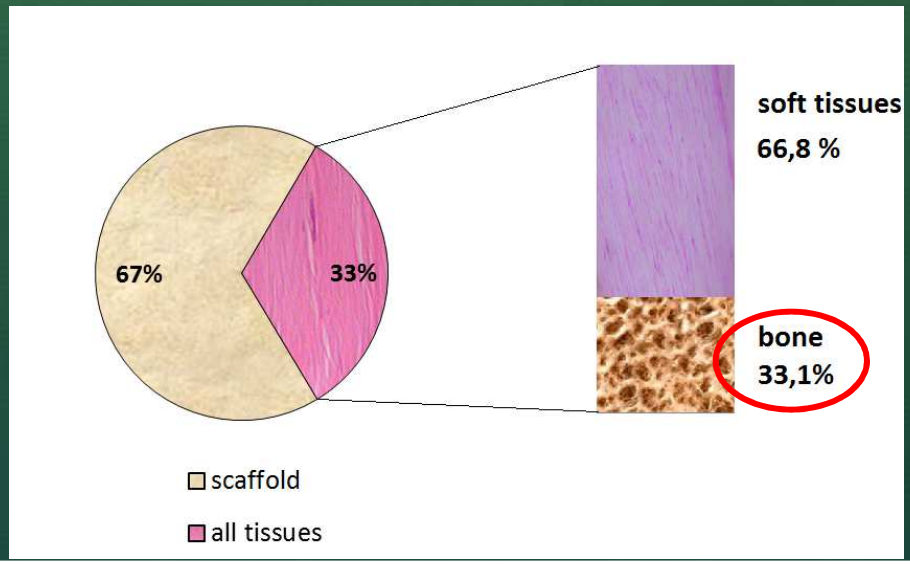
Pure PCL



PCL + nanoHAP



In the samples with uncoated PCL <u>new bone formation was almoust not detected.</u>



Acknowledgements

MATERA

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Dr Mara Pilmane

Dr Ilze Salma

Professor Wojciech Święszkowski

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