“Functionalization of biomaterials using ultrasonic technologies"

Results of the MATERA project „SONOSCA”

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Calcium phosphate bioceramics
Other application areas

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

WP1
NPs by microwave solvothermal 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
GoHAp™ nanopowder:

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

Polymer scaffolds – 3D printing

Made by Technical University in Warsaw

Material – PCL
Ceramic β-TCP scaffolds
Ceramic β-TCP scaffolds
Both scaffolds with similar porosity

β-TCP

PCL (Polycaprolactone)

- Filling into the mold
- Viscous mass foaming (80°C-120°C)
- Sintering
Functional coatings on scaffolds

Acoustic cavitation phenomena

- Compression
- Rarefaction
- Bubble forms
- Bubble grows in successive cycles
- Reaches unstable size
- Undergoes violent collapse

5000°C
2000atm
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 before 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

\[ \beta\text{-TCP} \]

\[ \text{PCL} \]
In vivo tests - ceramics

Pure β-TCP

β-TCP + nanoHAP
In vivo tests - polymer

In the samples with uncoated PCL new bone formation was almost not detected.
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