Twinning to excel materials engineering for medical devices

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- **Department of Inorganic Chemical Technology**
- **Bioceramic Materials Group**
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- **Research topics**: Dense and macroporous sintered bioceramics and biocomposite materials, bioactive cements and coatings
- **Research expertise**: Synthesis, processing, characterization and applications in dentistry and biomedicine
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Biomaterials

- Research related to synthesis, processing, characterization and biocompatibility of bioceramic and biocomposite materials for bone tissue repair and regeneration.
- Development and application of macroporous biomaterials to provide support for new bone formation and act as carrier for different regenerative factors and reparative cells to stimulate osteinduction, osteoconduction and osteointegration.
- Ion dopping approach for inducing gene expression and antimicrobial properties.

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Biomaterials

***Materials*:**

- 3rd generation of nanostructured HAP, β-TCP, α-TCP, bioglass powders dopped with various ions
- Hydrogels based on double network reinforced with aforementioned bioactive fillers
- HAP/TCP based scaffolds strengthen by polymer and composite coating approach
- Porous metallic implants coated with bioglass and HAP and loaded with hydrogels
- Loading of scaffolds with bioactive factors or extracellular vesicles for high osteogenic inductivity

Powder synthesis methods: precipitation, hydrothermal, sol-gel.

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Biomaterials

- ***Processing:***
  - dense or porous ceramics by conventional sintering, microwave sintering, spark-plasma sintering, hot pressing
  - ceramic scaffolds by sponge replica tecnique
  - α-TCP cements by thermal treating of nonstoichiometric HAP
  - glass-HAP coatings by electrophoretic deposition, PLD, spray technique, dip-coating, spin-coating

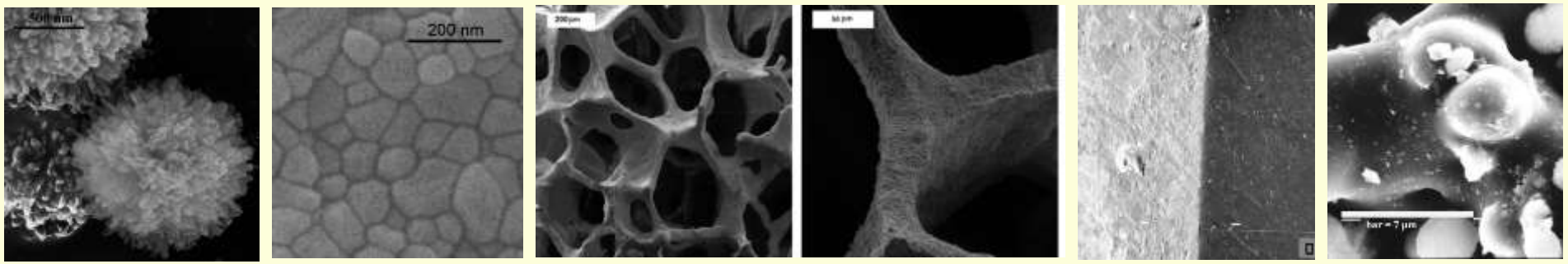

Fig.1: a) HAP particles, b) Nanostructured HAP obtained by MW sintering, c,d) HAP scaffold doped with Mg and Cu, e,f) graded glass –apatite coating on Ti6Al4V

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Facilities

- Field emission gun scanning electron microscope (FEG-SEM)
- BET Surface area analysis
- Energy dispersive X-Ray analysis (EDX)
- Cold Isostatic Press (CIP)
- High Temperature Furnaces (1600 °C)
- Atomic absorption spectroscopy
- Plasma enhanced chemical vapor deposition (PECVD)

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Needs

- Cooperation in design of 4th generation of biomaterials and joint investigation of their application in biomedicine and dentistry
- 3D printer for ceramic and composite slurries
- Furnace for microwave sintering of bioceramic scaffolds
- miRNA profiling in extracellular vesicles and miRNA profiling in treated cells
- Proteomic analysis of extracellular vesicles
- Morphological investigation of scaffolds in *in vivo* studies using CT scanners; histological analysis of tissue after in vivo implantation
- Transmission electron microscopy (HRTEM)
- X-Ray Photoelectron Spectroscopy (XPS)

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