

The « Phosphates, Pharmacotechnics, Biomaterials » group of CIRIMAT

- **Location:** Toulouse (ENSIACET and Faculty of Pharmacy) , France
- **Director/Coordinator :** Pr. Christèle COMBES
- **Contact person in NEWGEN:** Pr. Christèle COMBES - christele.combes@ensiacet.fr
- **Working Group involvement:** WG1, WG2
- **Staff:** 32 (5 Prof, 7 Ass. prof., 1 CNRS Res., 4 tech., 13 PhD students, 2 postdocs)
- **Research topics:**

Bioactive ceramics for bone substitution

Biopolymers and soft tissues engineering

Drug delivery systems

Biomineralisations, normal and pathological calcifications

- **Researcher expertises: pluridisciplinary team**

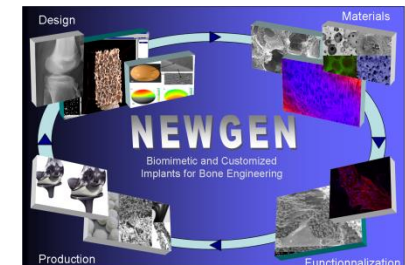
* Chemists: powder synthesis, physical-chemical characterisation, processing (coatings, cements, dense and porous materials/ceramics), crystallisation

* Pharmacists: solid or semi-solid formulations, drug delivery,

Eur. Pharm. regulations

*From powder synthesis
to medical device*

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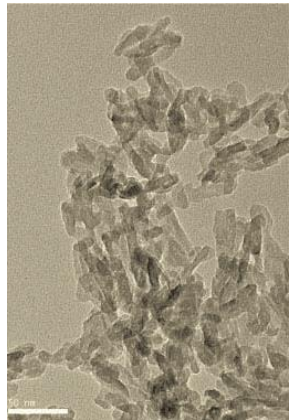
Powder synthesis

Calcium phosphates, calcium carbonate powders by co-precipitation:

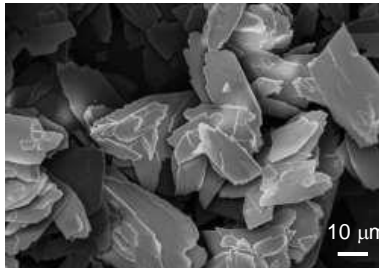
Crystalline and amorphous pure phases,

Biomimetic apatite analogous to bone mineral

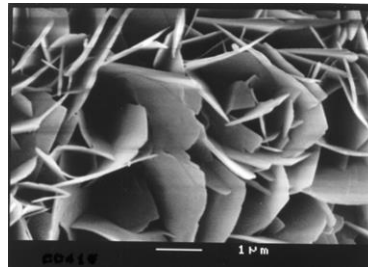
Substituted apatites (CO_3 , Cl, F, SiO_4 , Sr, Ag, Cu, Zn, ...)



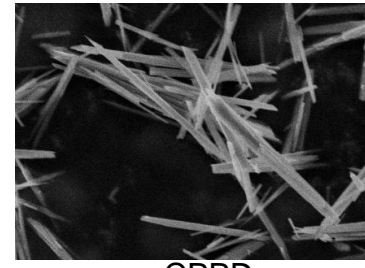
Nanocrystalline apatite



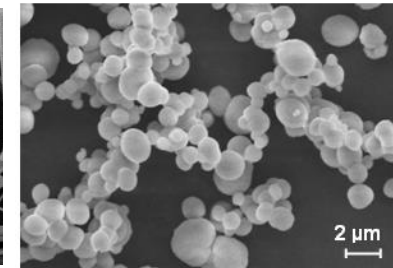
DCPD



OCP



m -CPPD

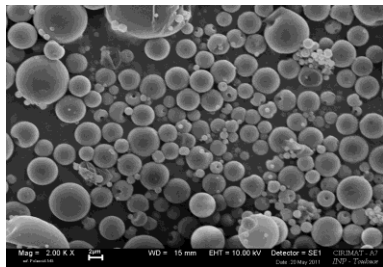


Vaterite

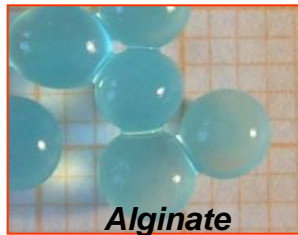
Hard and soft tissue substitute materials

Micro and nanoparticles, pastes,
porous and dense materials/ceramics, coatings,...

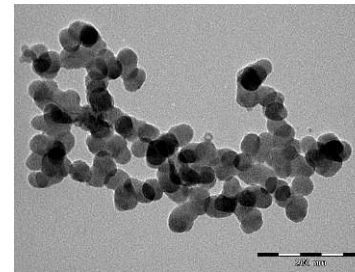
Controlled macro and/or microporosity



Hyaluronic acid

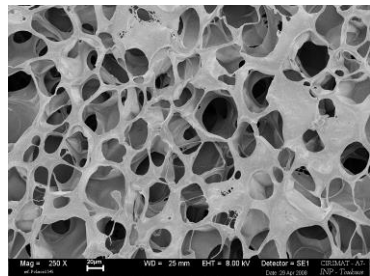


Alginate



Biopolymer-based particles,
scaffolds and films

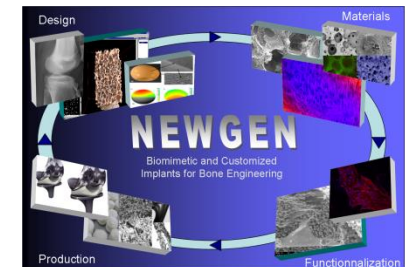
CaP- based
bioceramics



Alginate



Chitosan/alginate

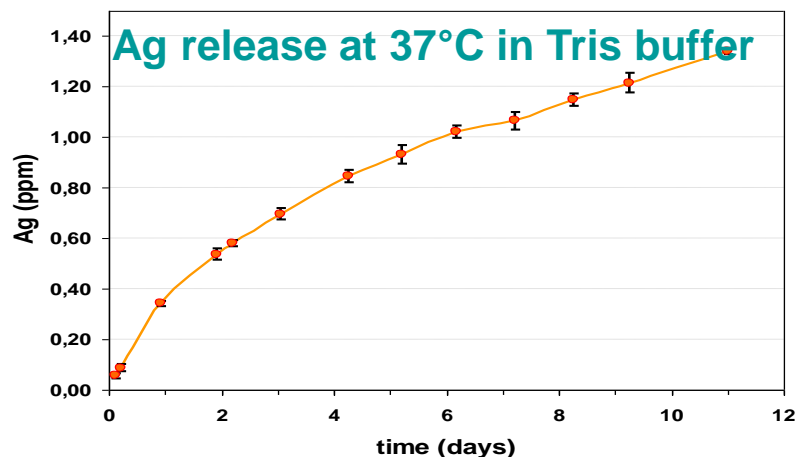


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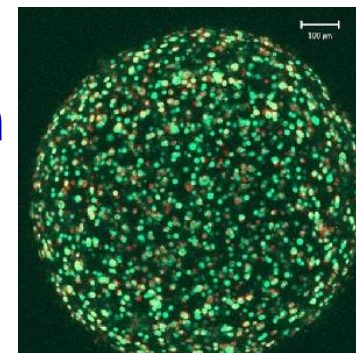
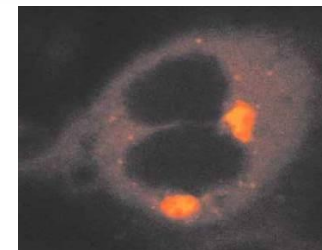
Tissue or cell drug-delivery

(bisphosphonate, rh-BMP2, antibiotic, Sr,..)

Antibacterial bone substitute



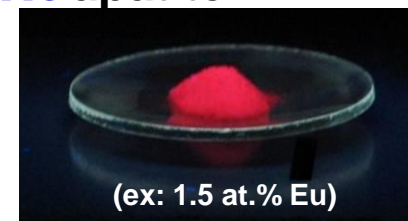
Cell encapsulation in biopolymer



Luminescent apatite



No excitation

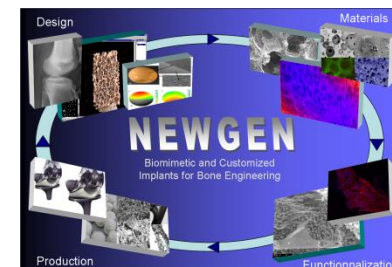


(ex: 1.5 at.% Eu)

Excitation at 253 nm

**BIOCAPABILI Engineering cluster
on innovative antimicrobial materials**

<http://www.biocapabili.com/>

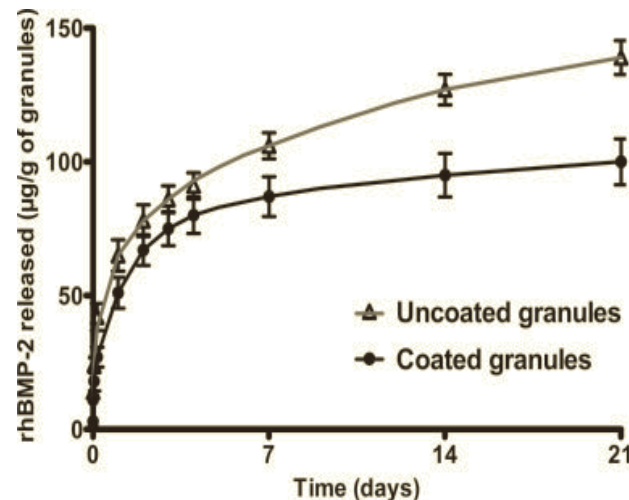
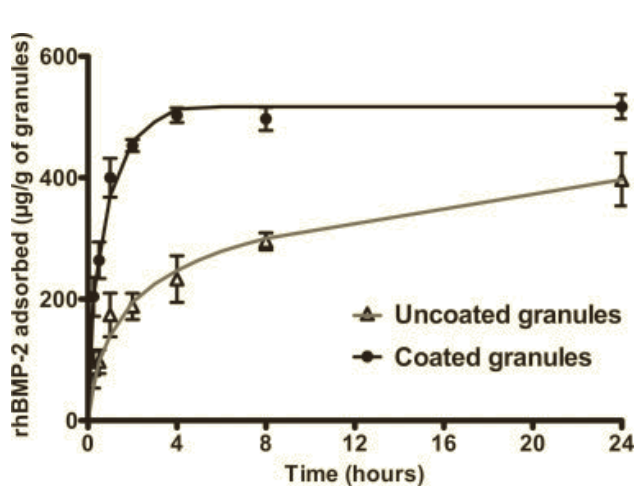


Biomimetic apatites: adsorption and release properties

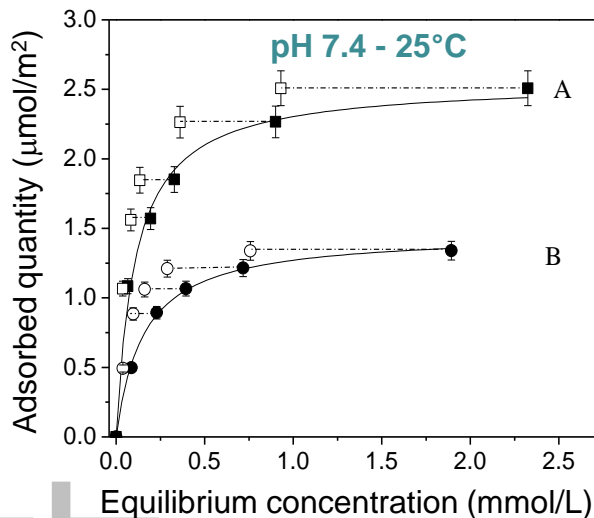
rh-BMP2



Granules coated or not with biomimetic apatite

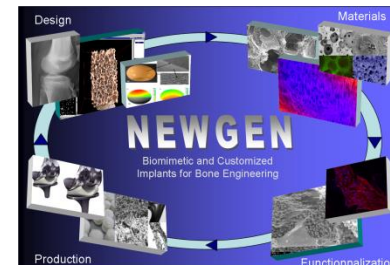


Bisphosphonate



A: nanocrystalline apatite (30 j)
B: stoichiometric HAP

■ ● adsorption
□ ○ desorption

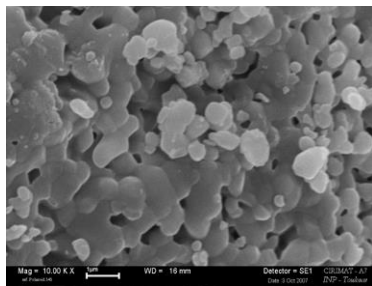
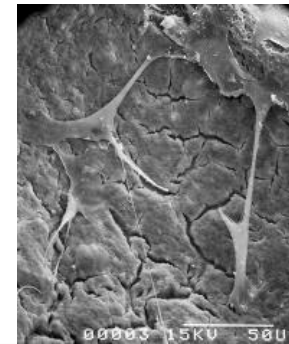


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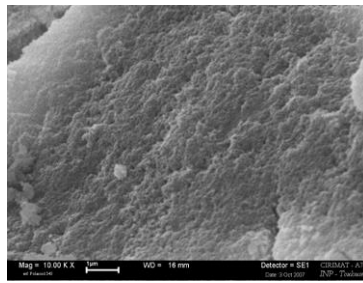
CIRIMAT– Technology transfer

Coll. Teknimed S.A - CIRIMAT:

Ceraform®Revolution is a porous bioceramic with a nanocrystalline carbonated apatite coating enhancing surface reactivity leading to better bone reconstruction

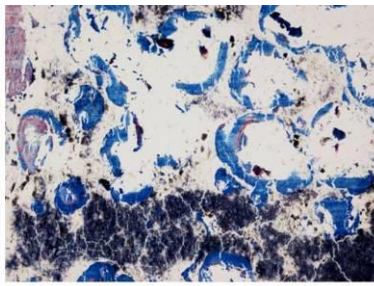
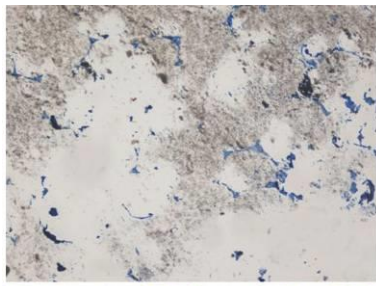


Raw HA-βTCP ceramic



Coated HA-βTCP ceramic

Scale bar = 1 μm

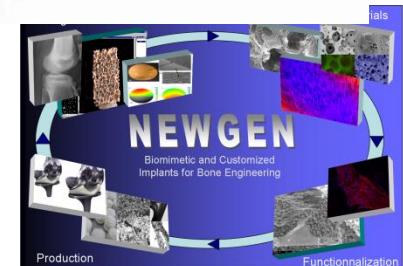


Technology transfer



Osteoinduction ?

US patent n°12 487 101 (2009)



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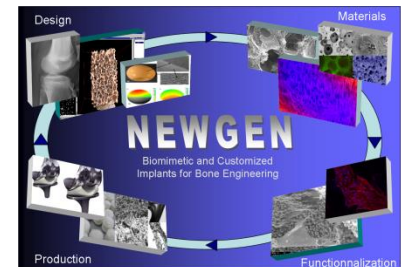
Synthesis (powders, gels): reactors, centrifugator,...

Crystallisation: Constant composition crystal growth technique

Characterisation:

- **Physical:** Hg porosimetry, specific surface area measurement (BET method), granulometry, rheometry, mechanical prop., AFM, X tomography, texturometer, friability tester, ...)
- **Chemical and structural:** XRD, FTIR and Raman (micro-)spectroscopy, AAS, UV-visible spectrometer, SEM, XPS, TGA-TDA ...

Thermodynamics: micro-calorimeter



CIRIMAT – Facilities

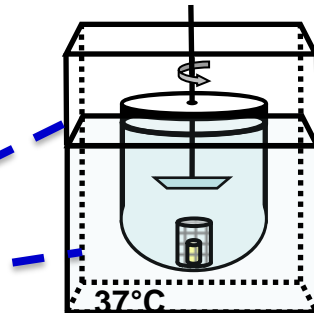


Processing-shaping:

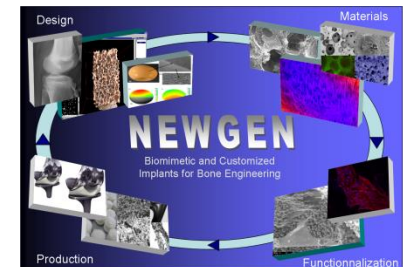
Spray-dryer, supercritical CO₂ equipment, encapsulator wet granulation machine, lyophiliser, SPS, tablet compression machines, mixer and grinder, ...

Drug release tests (Eur. Pharm.):

Dissolutest, continuous flow cells



Welcome to PPB group of CIRIMAT !



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