

# Local drug delivery from bone implants

i-SUP 2008

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# OUTLINE

- orthopaedic implant related infections
- systemic versus local drug delivery
- optimal antibiotic release profile
- porous Ti (alloy) bone implants
- calcium phosphate coatings
- biomimetic precipitation
- hydroxyapatite fibres
- polymer coatings
- conclusion



# ORTHOPAEDIC IMPLANT RELATED INFECTIONS

- enormous number of orthopaedic implants
- low incidence of infection (0.5-5%)
- serious consequences:
  - simple debridement and antibiotic treatment
  - implant removal and replacement
  - patient trauma
  - prolonged hospitalization
  - high medical costs



osteomyelitis



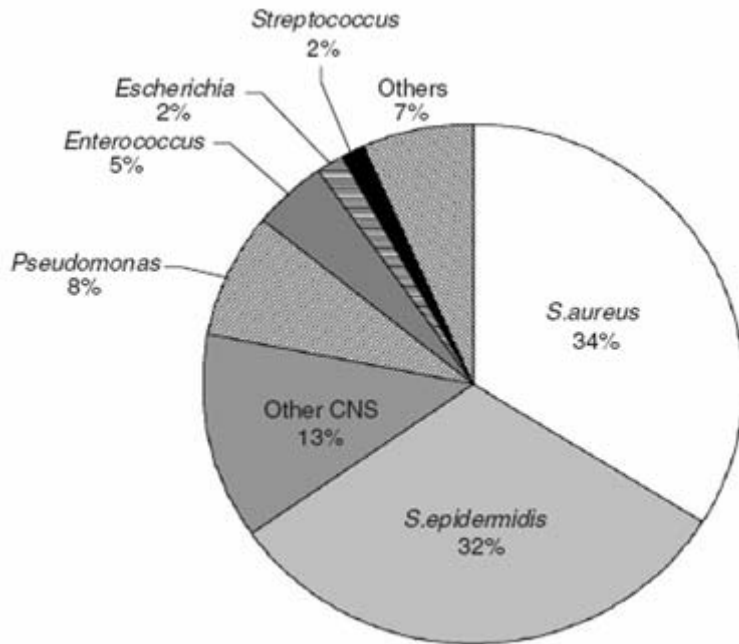
# SYSTEMIC VERSUS LOCAL DRUG DELIVERY

- systemic antibiotic administration:

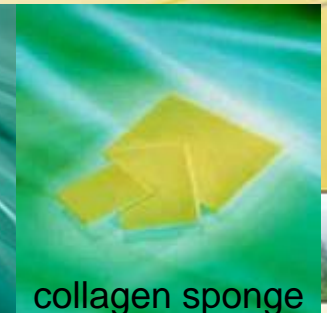
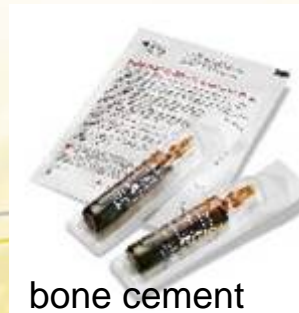
- limited blood circulation
- biofilm
- high doses
- systemic adverse effects

- local drug delivery systems:

- high local concentrations
- no systemic adverse effects

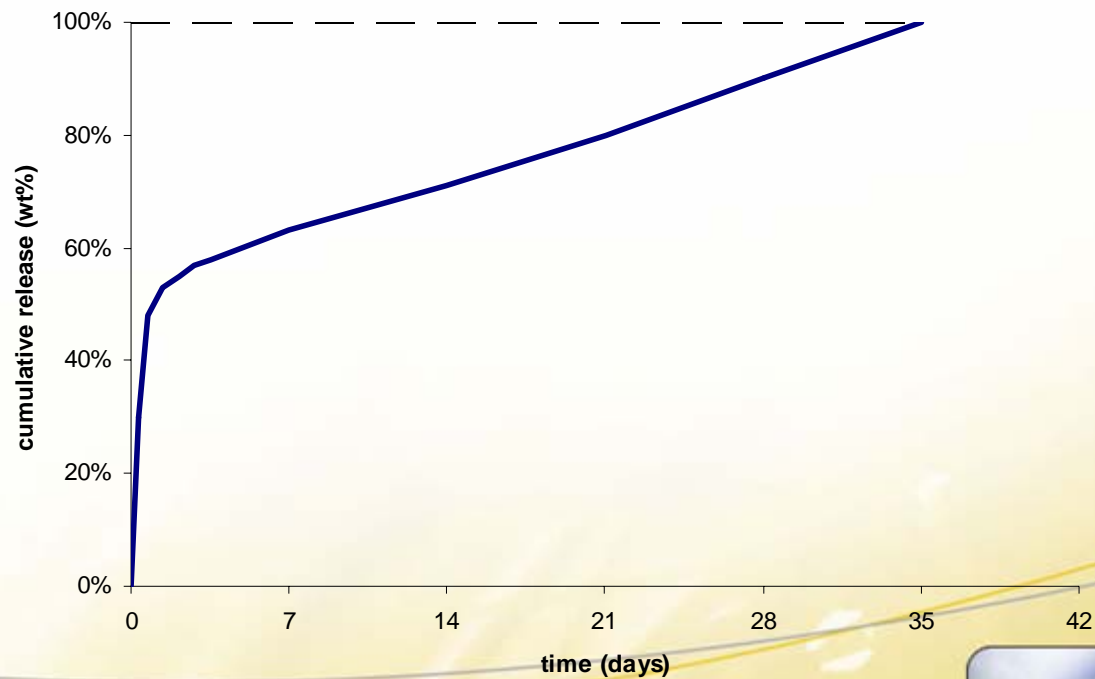


Frequency of main pathogenic species  
(Campoccia et al., 2006)

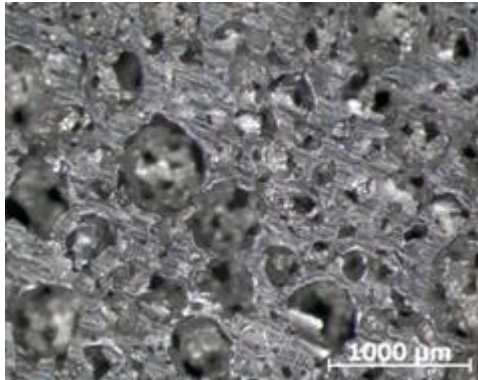


# OPTIMAL ANTIBIOTIC RELEASE PROFILE

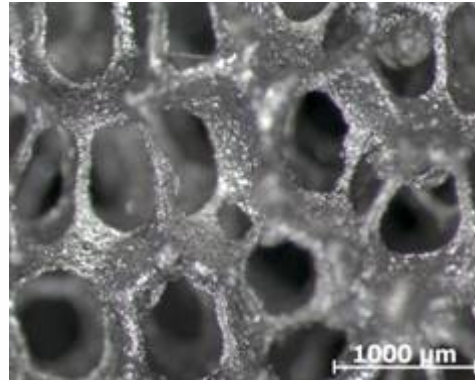
- initial burst release
- therapeutic concentrations during 4-6 weeks



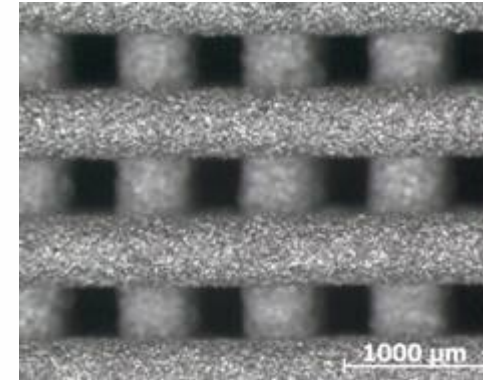
# POROUS Ti (ALLOY) BONE IMPLANTS



gel casting



PU replica



3D fibre deposition

- porosity: new bone ingrowth  $\Rightarrow$  implant fixation
- Ti (alloy):
  - excellent biocompatibility
  - mechanical properties for load bearing applications



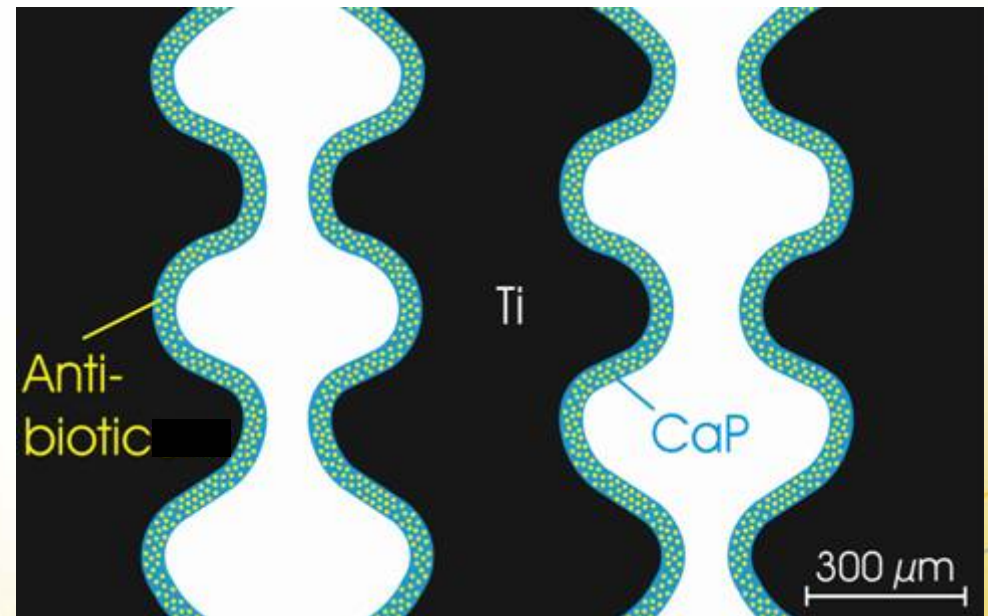
# CALCIUM PHOSPHATE COATINGS

- bioactive: bone bonding

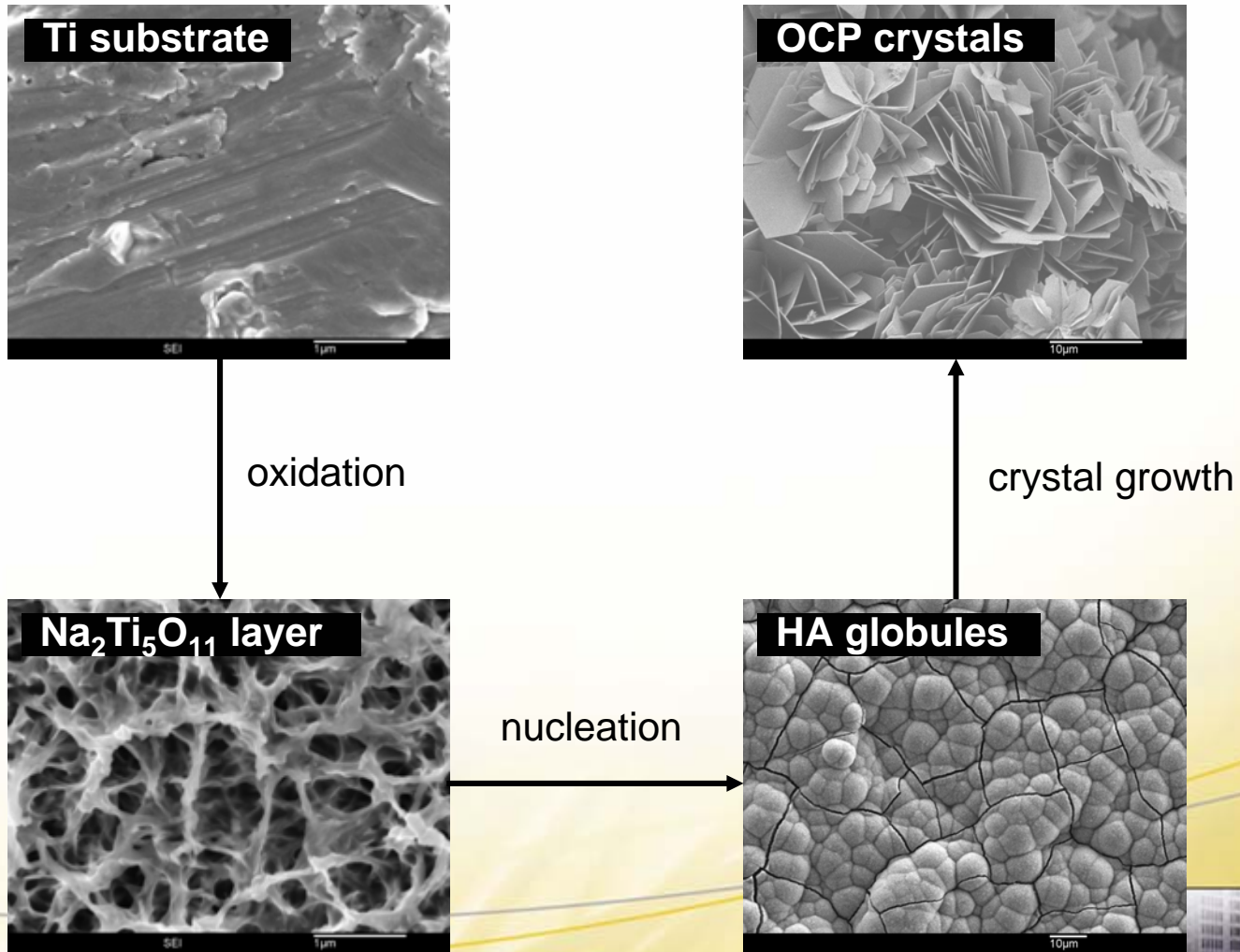


HA coated hip stem

- drug delivery matrix

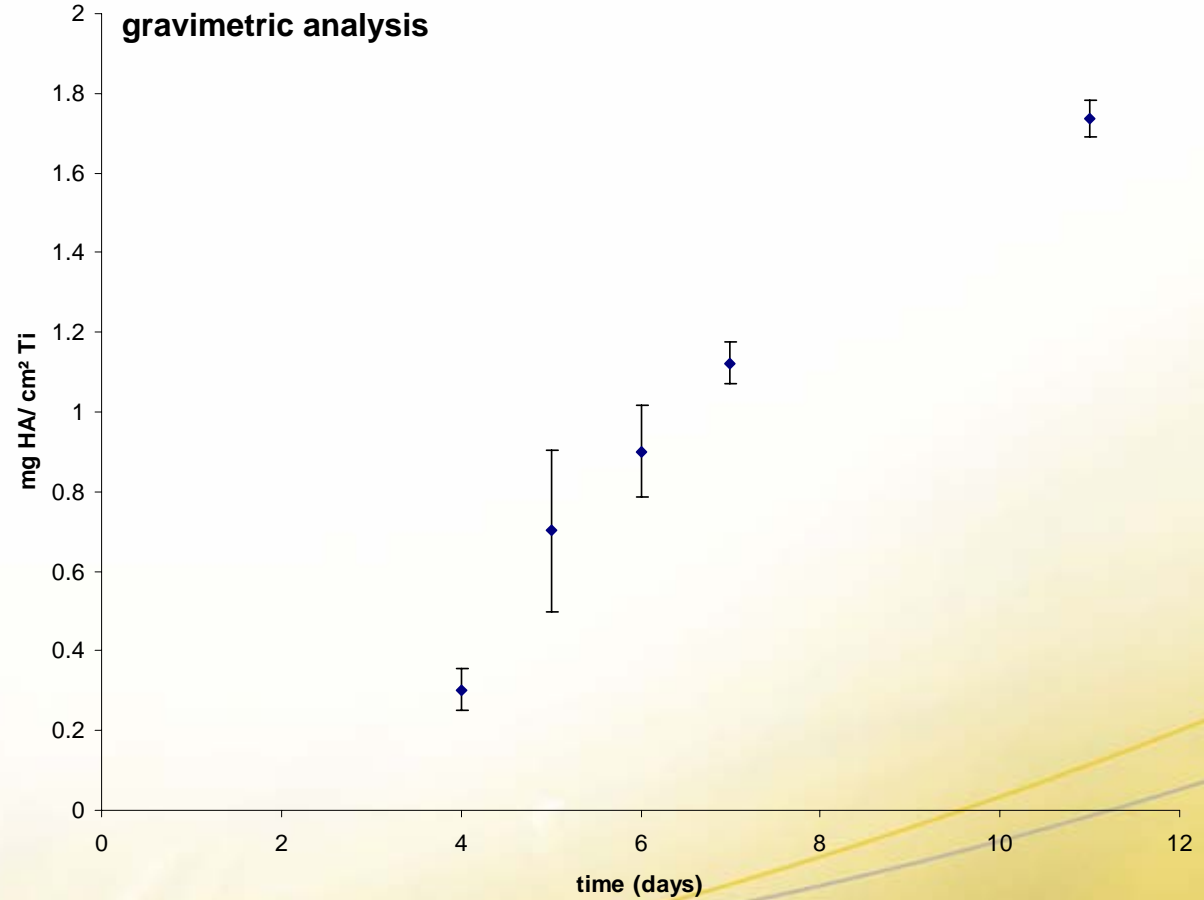
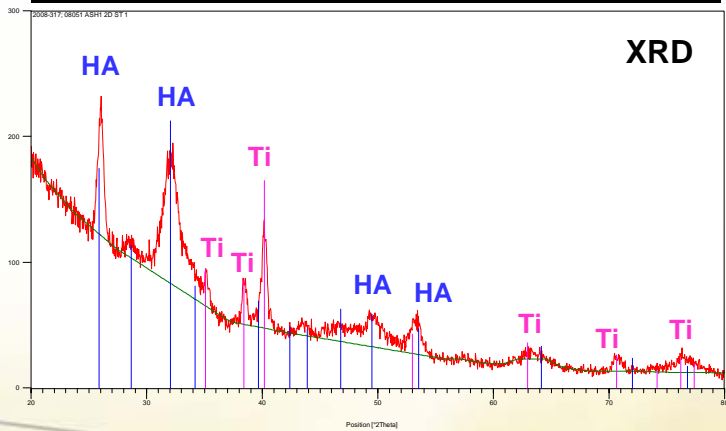
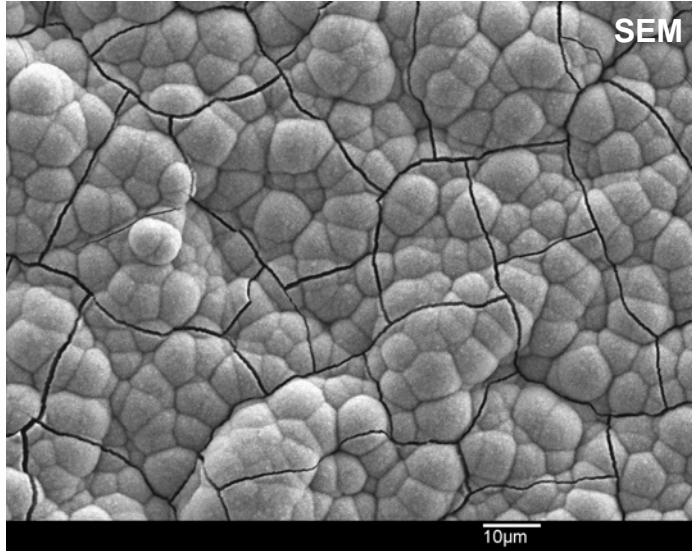


# BIOMIMETIC PRECIPITATION

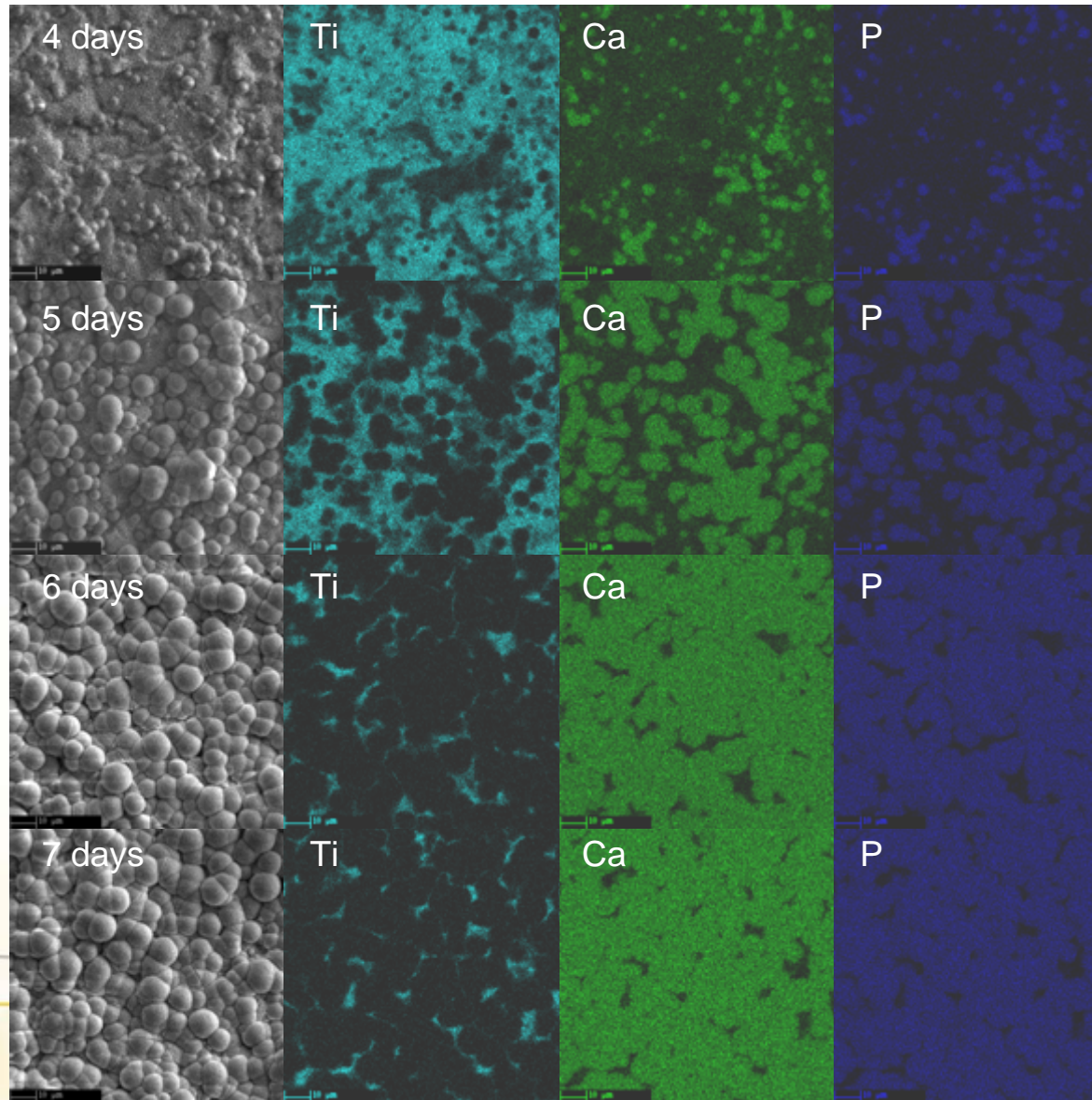




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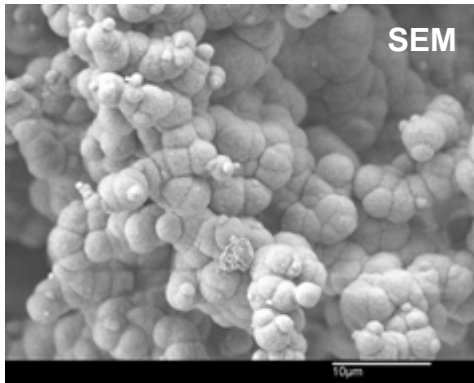


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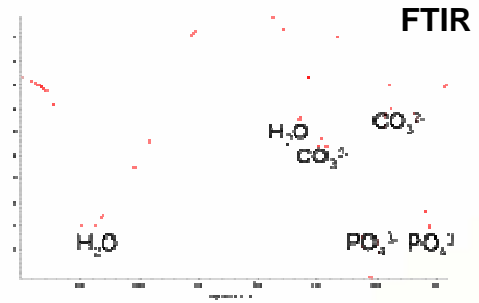
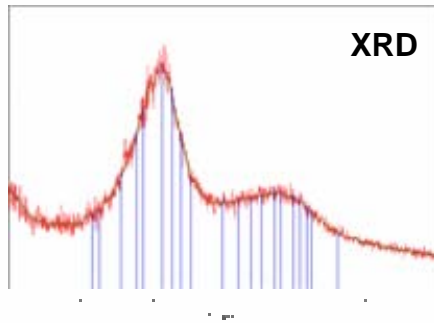


EPMA mapping

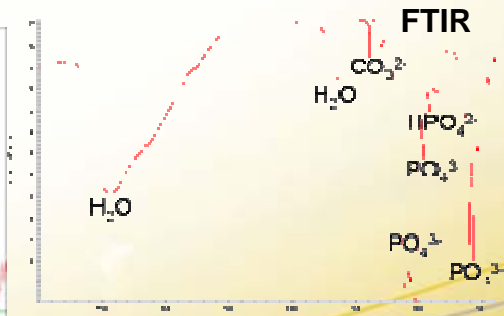
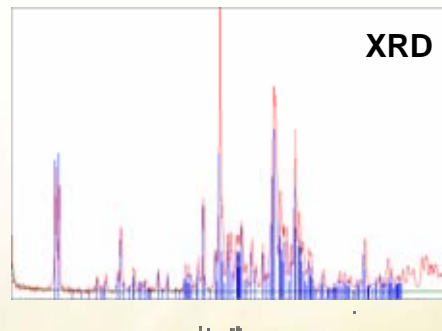
# BIOMIMETIC PRECIPITATION



carbonated apatite

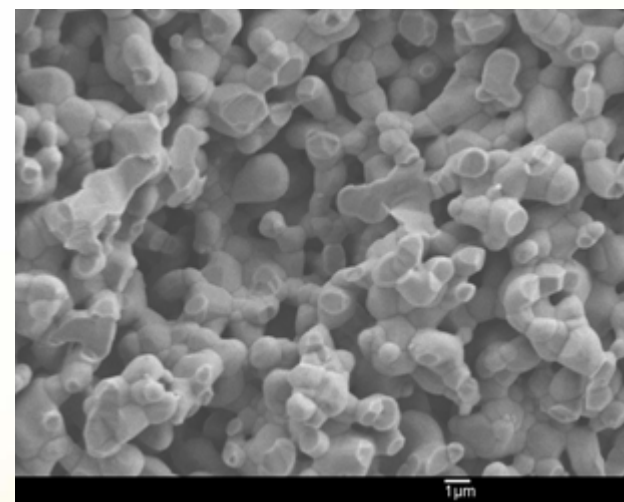
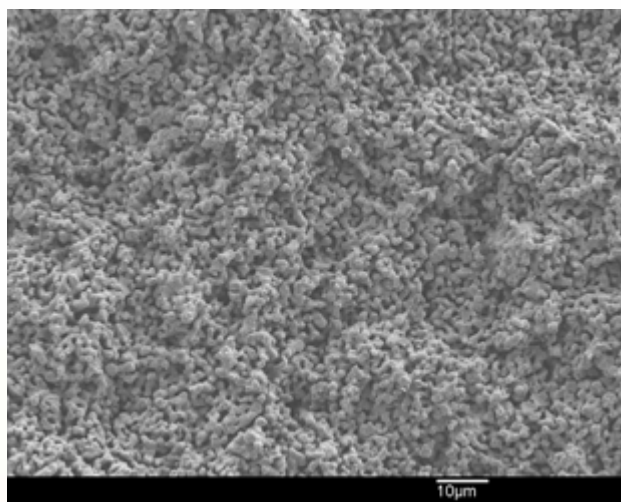
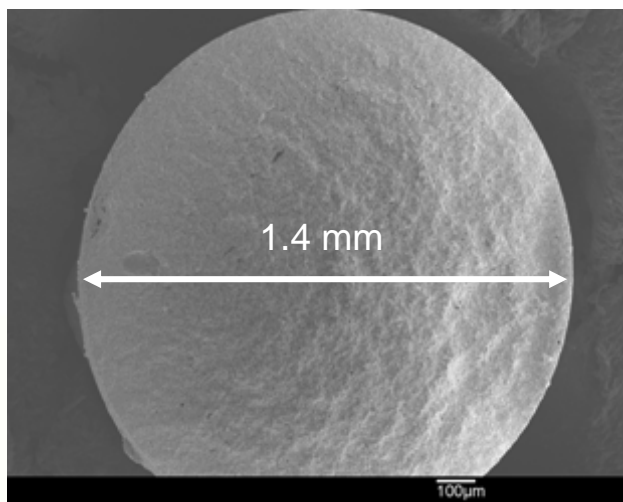


octacalcium phosphate



# HYDROXYAPATITE FIBRES

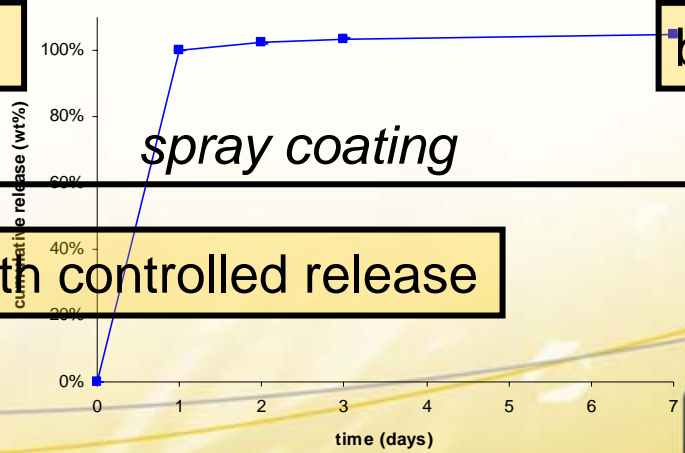
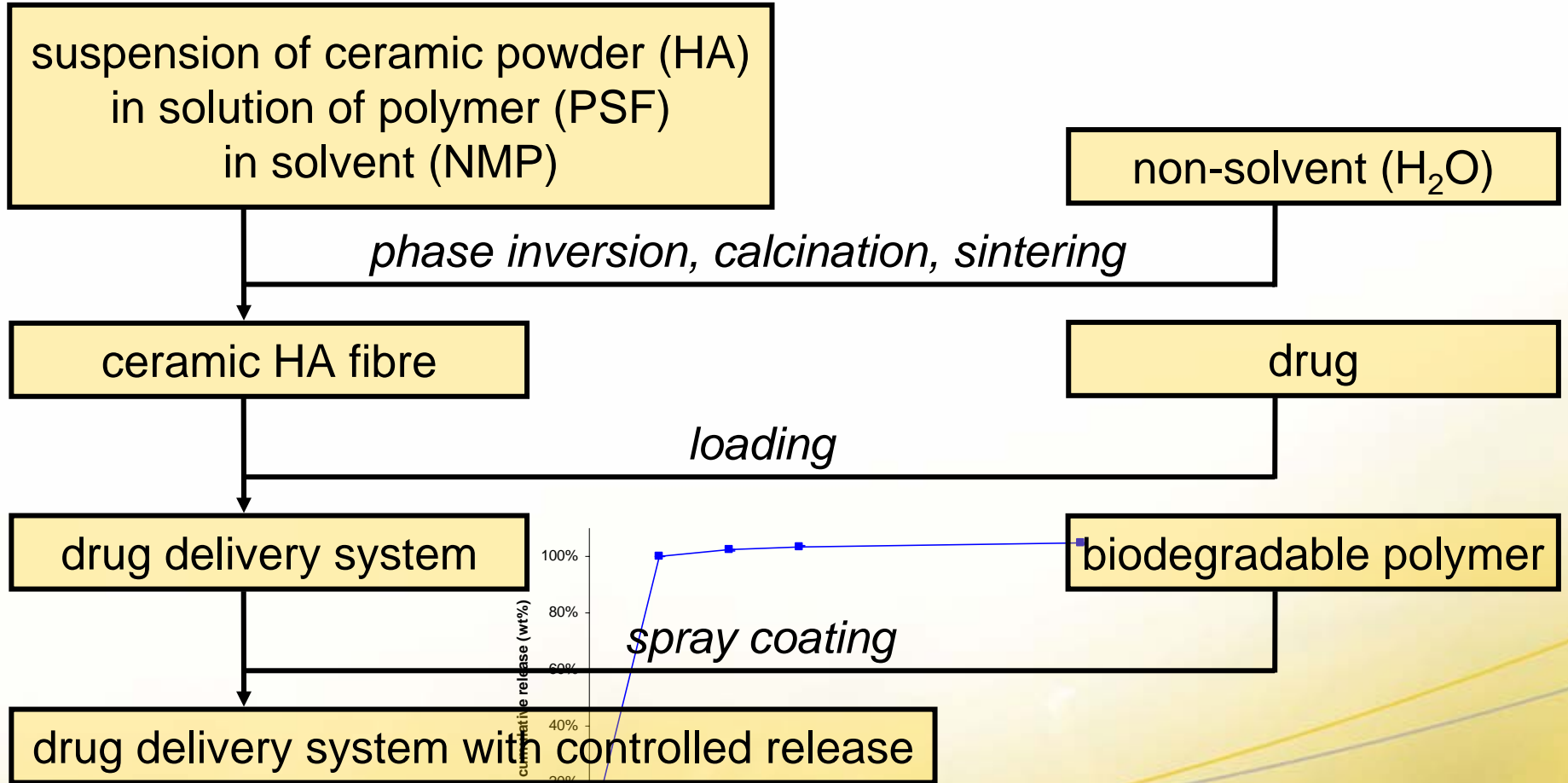
as a model for the calcium phosphate drug delivery matrix



porosity: 51 v%  
pore size: 1 µm



# HYDROXYAPATITE FIBRES

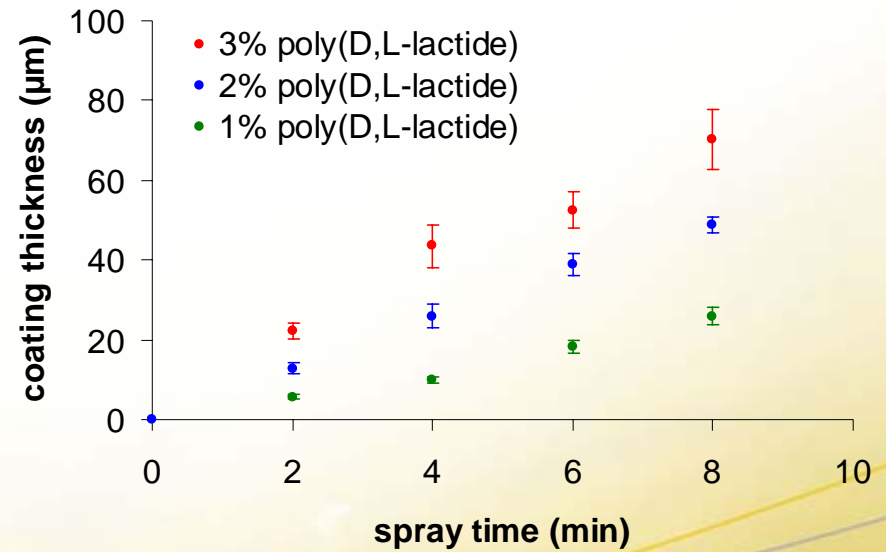
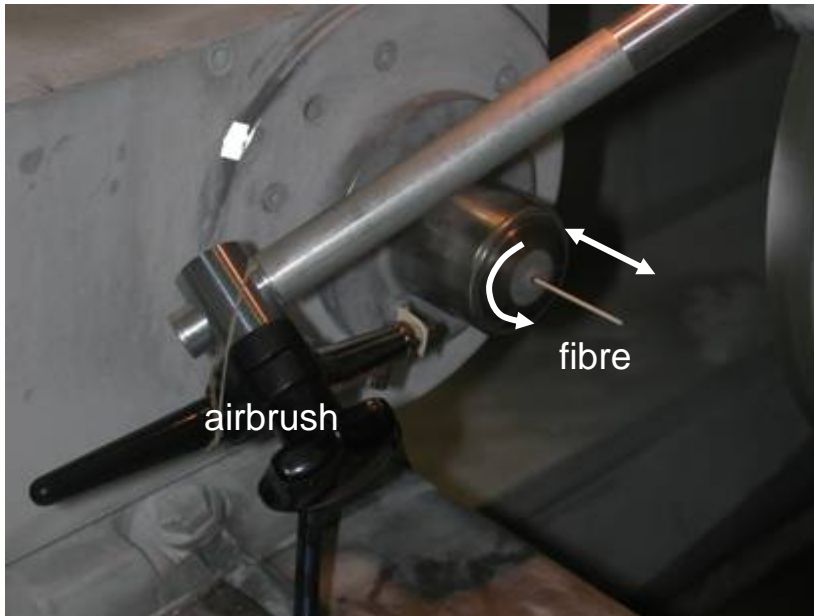


HA: hydroxyapatite; NMP: N-methylpyrrolidone; PSF: polysulfone

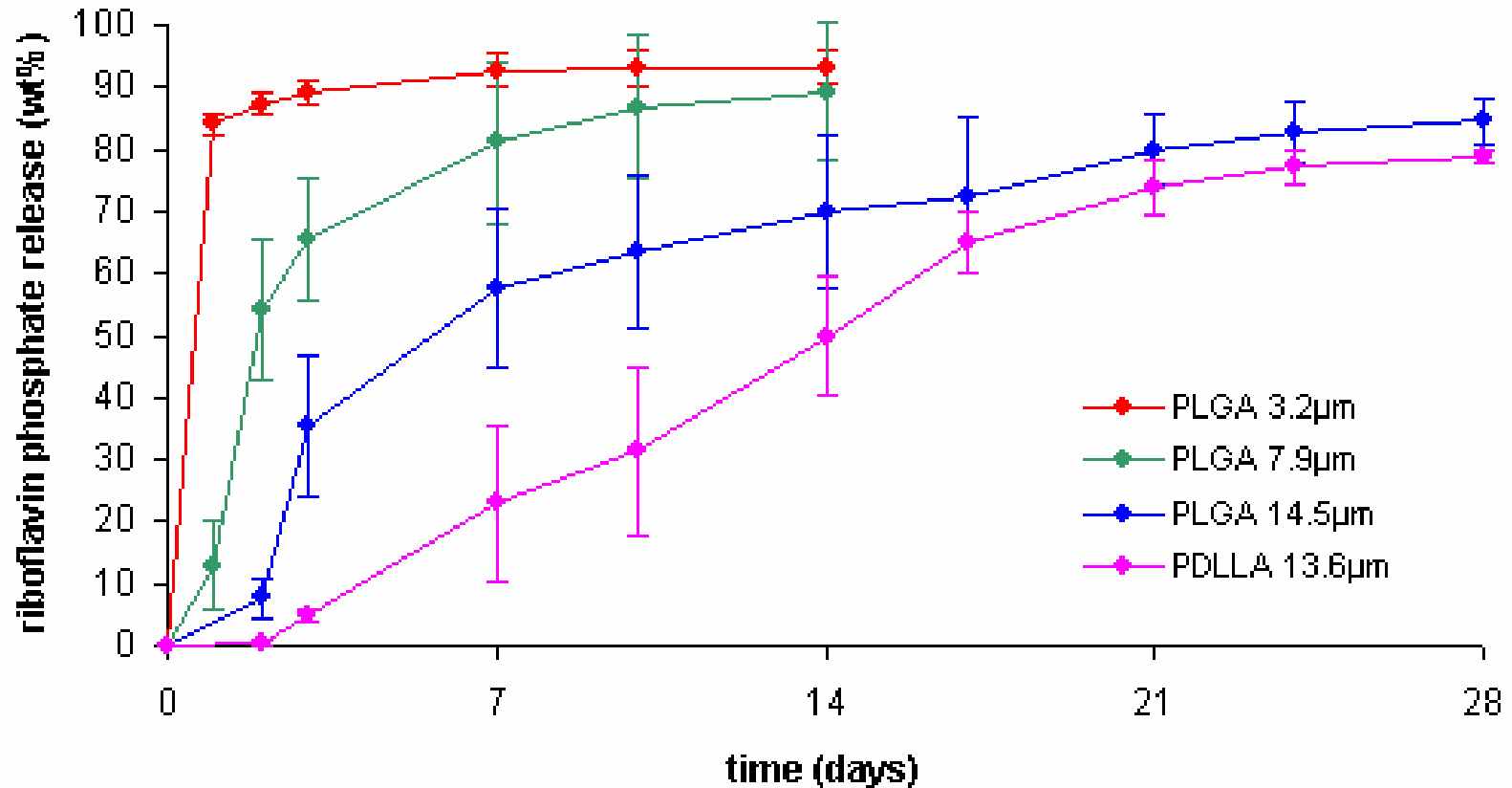


# BIODEGRADABLE POLYMER COATING

spray coating



# BIODEGRADABLE POLYMER COATING



# CONCLUSION

porous Ti (alloy) bone scaffolds,  
coated with a calcium phosphate matrix,  
loaded with an antibiotic and  
coated with a biodegradable polymer



- new bone ingrowth into the implant
- load bearing applications
- bone bonding
- high local antibiotic concentrations
- no systemic adverse effects
- optimal drug release profile

