Calcium phosphate micro- and nanocrystals synthesized in a organic solvent

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Introduction

Calcium phosphates (CaPs) are widely used as biocompatible materials for bone defect treatments. This study shows the results of a new approach to produce various crystalline CaP nano- and microparticles.

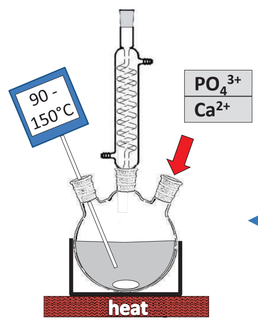
	common methods: high temperature processes, precipitation in aqueous solutions	**new approach:** precipitation in organic solvents
pros	high yield	non-agglomerated, monodispersed particles
cons	agglomerated, polydispersed particles	low yield

Possible **applications** are nacre-like composite materials (produced with crystalline platelets) and injectable and fast setting cement materials (using crystalline spherical nanoparticles).

Method & Results

Our synthesis method is based on the work of **Tao et al.**[1] and **Galea et al.**[2]
We used two different methods for the particle production:

single batch method

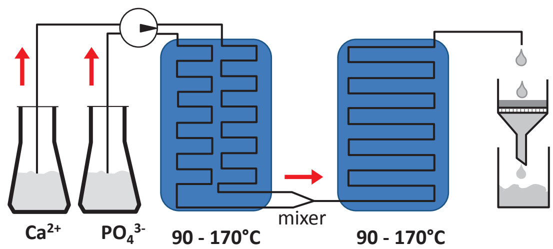


(e.g. Na_2HPO_4 and $CaCl_2$ in ethylene glycol)

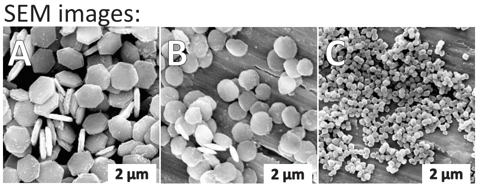
yield: 200mg/500ml (≈ 50-80mg/h)

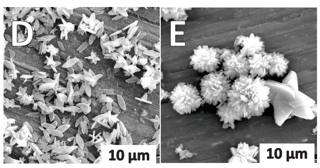
variable parameters: T, pH, t, conc.

continuous tubular reactor



SEM images:



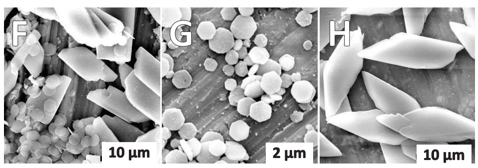


A: hexagonal β-TCP platelets
B: elliptically-shaped β-TCP particles
C: β-TCP nanoparticles

} size: 0.1-1.2 µm; size dispersion: <10 %

D: parallelepiped-shaped monetite platelets
E: urchin shaped monetite balls

} size: several µm; size dispersion: 20-30 %



F: β-TCP + monetite platelets
G: β-TCP platelets
H: monetite platelets

- higher yield with this method (up to 200 mg/h)
- but higher size dispersion

Discussion & Conclusions

Our first research efforts show that it is possible to synthesize non-agglomerated and monodispersed calcium phosphate particles. Their size, shape and composition can be influenced by varying reaction parameters like temperature, pH, reaction time and precursor concentration. In the batch method the non-agglomeration of the β-TCP particles could be confirmed by the narrow and monomodal particle size distribution curves obtained by laser diffraction. Analysis of the SEM results show that the size distribution is higher for monetite than for β-TCP particles. With the continuous tubular reactor we could show that it is possible to increase the yield but in the same time the size distribution is higher.

References

1) J. Tao, W. Jiang, H. Zhai, H. Pan, X. Xu, and R. Tang (2008) *Crystal Growth & Design*, **8**(7), 2227
2) L. Galea, M. Bohner, J. Thuering, N. Doebelin, C. G. Aneziris, T. Graule (2013) *Biomaterials,* 34, 6388-6401