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Bioinspired Chitinous Scaffolds for Bone Regeneration

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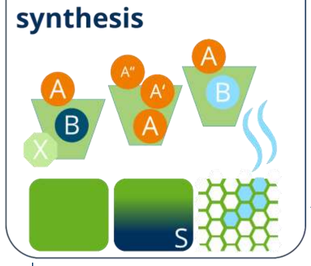
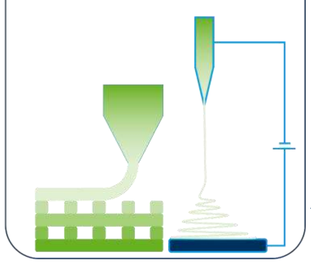
ifw Institut für Werkstoffwissenschaft materials science

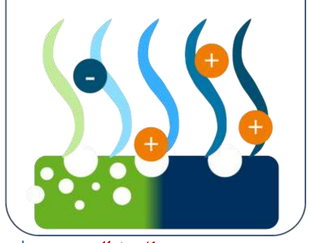
Biomaterials synthesis



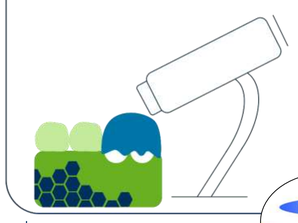
Biofabrication



Degradation

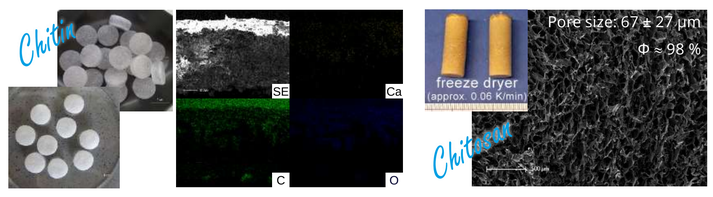


Materials analytics & cell biology



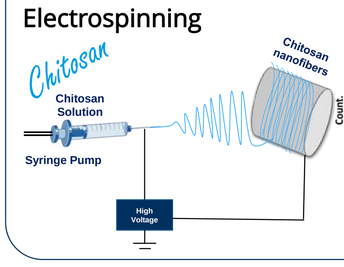
Cell culture & cell manipulation

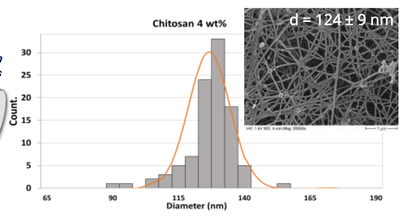
Porous Scaffolds



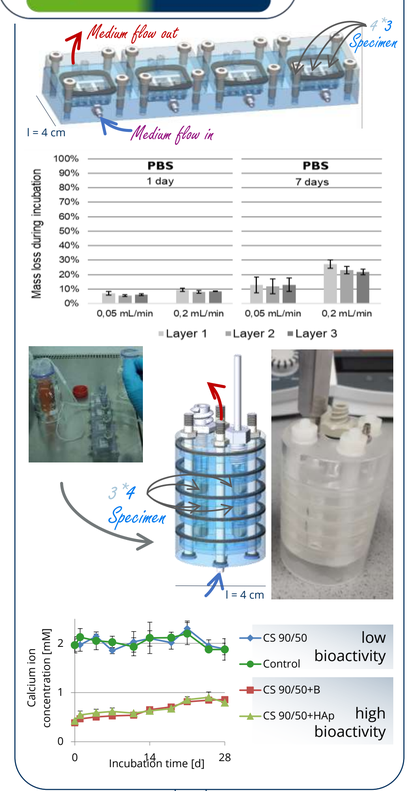
3D-plotting of Hydrogels

Electrospinning





Chitosan (4 wt% in 85 % AcOH)
eSpinning: V= 17-18 kV, FR= 0.5 $^{mL}/_{h}$, D=12 cm

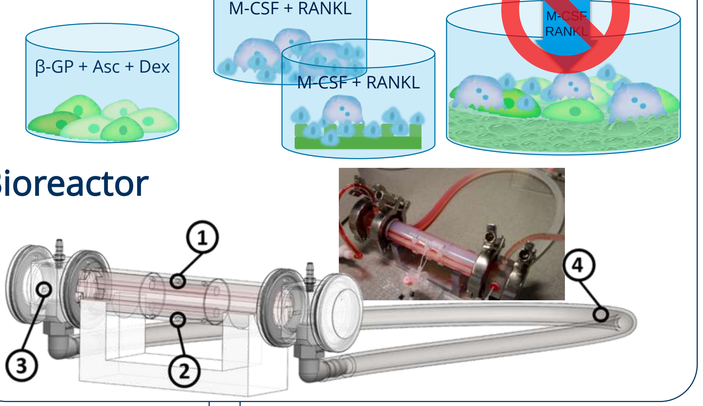


Ob/Oc-co-culture

a) Human bone marrow stromal cells → Osteoblasts

b) Human Monocytes → Osteoclasts

c) Osteoblast/Osteoclast co-Culture

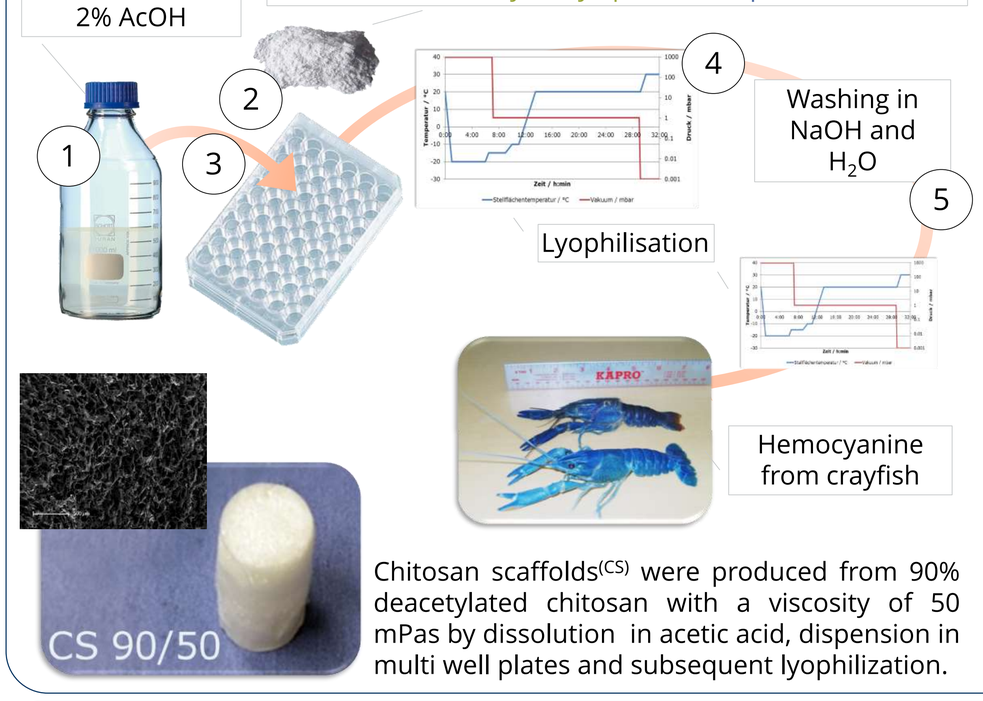


Bioreactor

Results on macroporous chitosan scaffolds

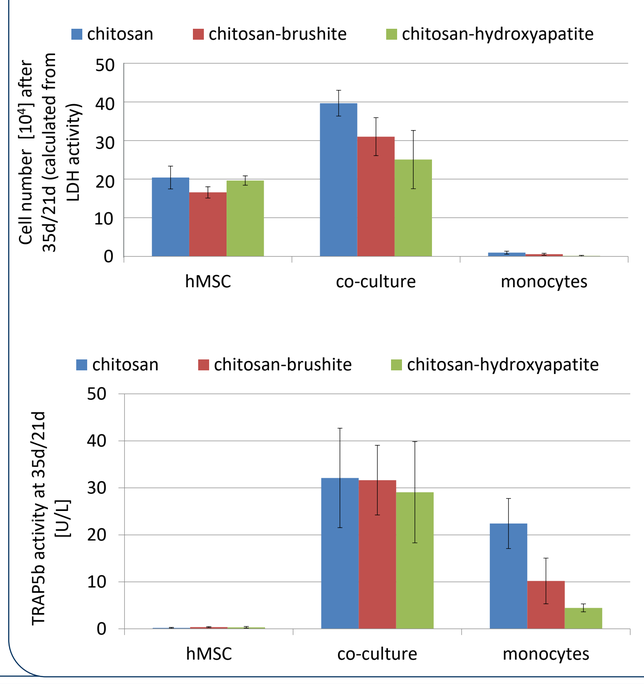
1% Chitosan in 2% AcOH

Brushite(B) / Hydroxy apatite(HAp) / plain(CS 90/50)



Chitosan scaffolds(CS) were produced from 90% deacetylated chitosan with a viscosity of 50 mPas by dissolution in acetic acid, dispension in multi well plates and subsequent lyophilization.

Ob/Oc-co-culture



Co-culture proved increased LDH-activity of hMSC owing to interaction with monocytes. **Calcium phosphates influenced hMSC proliferation** indirectly by monocytes.

Osteoclast formation in monocyte mono-culture was influenced by calcium phosphate modification of CS. Therefore addition of M-CSF and RANK-L during mono-culture was necessary. Remarkably, the **osteoclastogenesis occurred in co-culture without any additives**.

Materials & Methods – mesenchymal stem cell and monocyte (co-)culture

Osteoclastogenesis: Monocytes, isolated from human buffycoat were transferred onto chitosan scaffolds and cultivated 14 days in α-MEM. Osteoclastic differentiation was induced by M-CSF and RANK-L. Osteoblastogenesis: HMSC, isolated from human bone marrow, were transferred onto chitosan scaffolds and cultivated for 14 days in α-MEM (-OS). Osteoblastic differentiation was induced by supplementation of 50 µM ascorbate, 5 mM β-glycerophosphate and 10 nM dexamethasone after day 3 (indicated by: +OS). Osteoblast/Osteoclast-co-culture: After mono-culture of hMSC for the first 12 days with and without addition of osteogenic supplements the co-culture is started on day 13 by seeding of monocytes. HMSC and monocytes are co-cultivated for further 14 days. DNA and LDH activity were measured to calculate the cell number and the number of cell nuclei. ALP activity corresponds to the osteoblastic differentiation while osteoclastic differentiation is characterized by TRAP5b activity.

DFG Deutsche Forschungsgemeinschaft

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