

- 1 *Stained biofunctional surface layer of hydrogels.*
- 2 *Cross-linking of hydrogels in UV reactor.*

BIOFUNCTIONAL MATERIALS – FUNCTIONALIZED BIOMOLECULES FOR MATERIAL DESIGN

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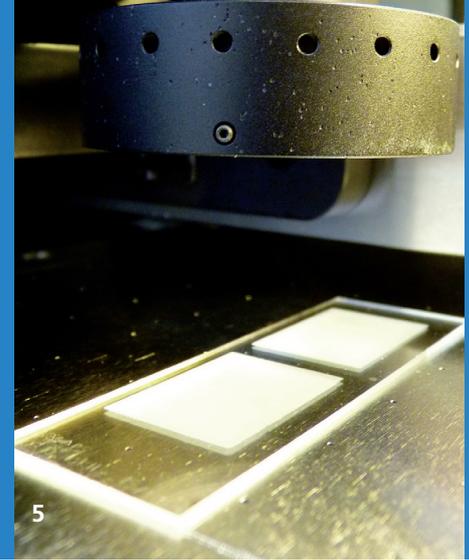
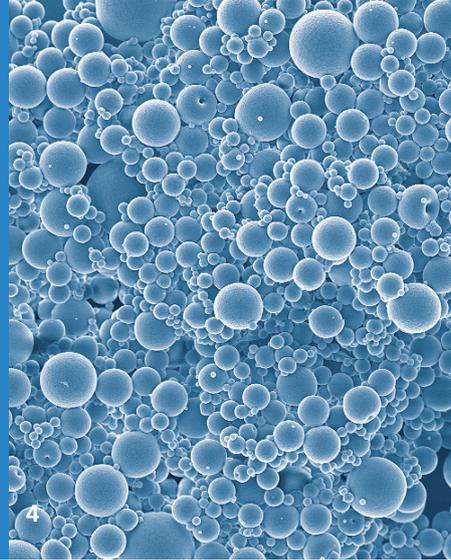
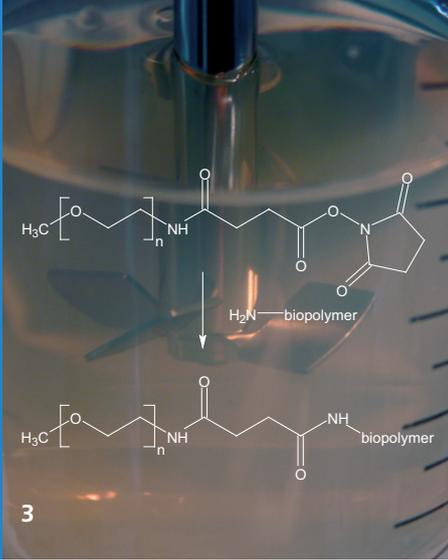
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Biomolecules are highly attractive materials which are produced and optimized by nature. They can meet complex challenges such as storage and release of water, biological signalling and even the formation of a biofunctional matrix to host living cells. We cannot rebuild such comprehensive function by chemical synthesis, but we can modify biomolecules and use them in material design. We can adjust their properties for better blending into synthetic materials or for improved processing properties for example.

Modification of biomolecules

We use various conjugation techniques in order to integrate additional functional groups into biomolecules, such as:

- Reactive sites for chemical cross-linking and surface immobilization
- Reactive sites for coupling of dyes or biological effector molecules
- Hydrophilic or hydrophobic side chains for the adjustment of solubility



Hydrogel systems

The cross-linking of hydrophilic biopolymers results in hydrogel networks. By varying the number of cross-linking sites we can adjust the gel properties such as swelling behavior and elasticity. The cross-linking reaction can be activated at various conditions by choosing different mechanisms such as radical polymerization, click chemistry or initiator-free thermal and photosensitive cross-linking.

Gels can be designed to meet specific needs:

- Tailored elastic properties
- Gels resembling the matrix of tissues
- *In-situ* cross-linking gels

Surface functionalization

All materials are importantly defined by their surface properties. Materials which are supposed to interact with biological systems need biological recognition motifs to become so called biomaterials. We outfit biomolecules such as polysaccharides, glucosaminoglycans and proteins with linker molecules and reactive groups for covalent immobilization onto surfaces.

We provide:

- Surface coatings for improved cell attachment
- Biofunctional particle shells e.g. for drug targeting
- Biosensor surfaces
- Anti-fouling or antibacterial surfaces

Formulation of biofunctional inks

Printing and dispensing of biological and biofunctional materials is a new and promising way of building free-form 3D objects, leading the way to customized implants and complex tissue printing.

Yet, the deposition techniques requires tailored materials, such as:

- Viscosity adjustment
- Surface tension adjustment
- Defined cross-linking reactivity

We offer biomolecule modification and bio-ink formulation including the development of bio-synthetic hybrid materials and the encapsulation of cells.

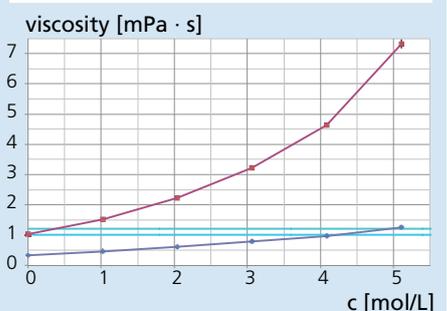
Biofunctional particle systems

Nanoparticle and microparticle systems are applied as carrier systems with the active compound loaded inside the particles cores or at the particle shell. We provide preparation of degradable particle cores, encapsulation of active biofunctional components and drugs and immobilization of targeting biomolecules to the particle shell.

We offer

- Biopolymer modification
 - Addition of polymerizable groups
 - Addition of reactive click chemistry functions
 - Conjugation of linkers, dyes
- Biomolecule immobilization
- Tailored hydrogels
- Particle-based release systems
 - w/o/w technique
 - Spray drying
 - Polylactides, chitosan
- Formulation of inks and resins
 - Inkjet printing
 - Dispensing
 - Two-photon polymerization (TPP)
- Inkjet printing of functional inks
- Cell encapsulation
- Biosensor development
- Analytical services
- Feasibility studies

Ink formulation.



- 3 *Chemical reactor for biomolecule modification reactions.*
- 4 *Degradable chitosan particles with drug load produced by spray-drying.*
- 5 *Ink-jet printing of biofunctional ink.*