

## Nanotechnology in Medicine

### Nanoparticles/structures for drug and gene delivery and hyperthermia

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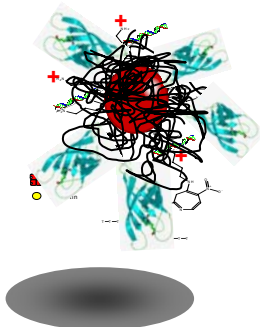
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#### Background and Introduction:

Nanomedicine is the application of nanotechnology to health. It exploits the novel physical, chemical and biological properties of materials at the nanometer range as well as the use of nanosized particles for surface engineering.

The aim of nanomedicine may be broadly defined as the comprehensive monitoring, repair and improvement of all human biological systems, working from the molecular level using engineered devices and nanostructures to achieve medical benefit.

#### The Nanoparticle



The most interesting nanosized particles for medical application are superparamagnetic iron oxide with tailor-made coatings and derivatizations. Such particles have a size of 10 nm and are only magnetic in the presence of an external magnetic field. They are used as contrast agent for MRI, but in future also as non-viral vector for drug and gene delivery or as very local heat source for hyperthermia. Polymer particles are used for structuring surfaces at the nanoscale which allows the manufacturing of drug reservoir and controlled release by diffusion through nanochannels.

#### Targeted Drug Delivery and Controlled Release

The drug delivery systems enabled by nanotechnology aims to target selected cells or receptors in the body. The aim is that nanoparticles will carry therapeutic payloads or genetic content into diseased cells, minimizing side effects as the nanoparticles will only become active upon reaching their ultimate destination. They may even

check for over dosage before becoming active, thus preventing drug released poisoning.

Two concepts are in development in the laboratory of LTP:

1. Drug or gene delivery with superparamagnetic iron oxide in joints using magnetic forces for guiding and targeting the drug. Our main applications are joint diseases because joints are ideal closed areas and the application of magnetic fields is relatively easy. We have shown that the targeting of the sinovia membrane with nanosized particles is possible. First results of in-vitro as well in-vivo gene delivery will be presented.
2. Nanostructuring of implant surfaces with nanoparticles: Tailor made pores in the size range from micro meter down to several nanometer in a hierarchical arrangement allow generating a novel drug delivery system on the surface of implants.

For structuring of the surface, colloidal coating processes were used applying soft-lithography techniques for the formation of large as well as small pores. The ceramic matrix guarantees high biocompatibility and adhesion of the structured layer.

#### Hyperthermia

Applying an AC magnetic field, SPION generate heat which allows a local heating of the tissue up to 44 to 45 °C. This is enough for necrosis of cancer cells. Combing this particle with bone cement, a very interesting system for stabilizing and treatment of cancerous bone was developed.

#### Literature

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