Engineering nanoparticles for tumor diagnostic

Master/Internship project

Research Group: Advanced Soft Matter group, Chemical Engineering TUDelft

Collaboration: Utrecht University Molecular Oncology group, Dr. Paul van Bergen en Enegouwen

Nanotechnology is a promising tool to improve traditional tumor diagnostics and treatment. Nanoparticles functionalized with targeting moieties can accumulate with high yields in the tumor environment facilitating diagnosis and treatment while reducing the side effects to healthy tissues.

In this project the student(s) will first work on the preparation of iron oxide (or gold) nanoparticles with a range of sizes and shapes. He/she will then focus on their surface functionalization to target the desired behavior in the different stages of the treatment: injection into blood stream, absorption in the tumor mass, MRI imaging and expulsion from the body. Ideally, the behavior will be following that of the schematic in Figure 1.

The surface of the nanoparticles will be functionalized to promote stability in the blood stream which is important to drive the particles toward the tumor. To improve accumulation in the tumor mass, the particles' surface will be modified with tumor targeting single-domain antibodies (VHH or nanobody). Once in the tumor, the particles need to aggregate to improve the imaging quality. Different aggregation mechanisms will be tested in relation to the specific properties of the tumor microenvironment, e.g. pH or presence of specific proteins. At this stage, both MRI imaging (for iron oxide) and treatment by thermal ablation (both iron oxide and gold nanoparticles) could be tested. After the diagnosis/treatment the particles need to be expelled from the body through the kidneys. It is therefore important that the aggregates formed in the tumor mass break down, by enzymes present in the tumor or by injection of a separate drug. In all cases different processes will be discussed and tested.

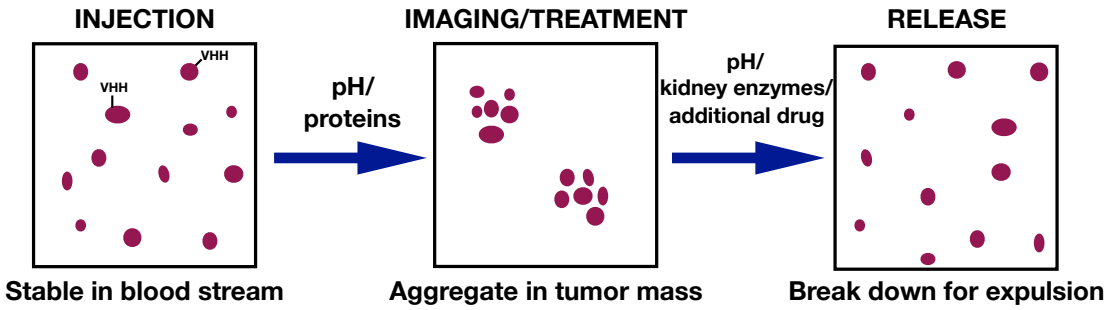

Figure 1 Ideal schematic operation mechanism of the nanoparticles prepared in this project.

In close collaboration with the Molecular Oncology group of Dr. Paul van Bergen en Henegouwen at Utrecht University, we will prepare different nanoparticle systems and perform tests *in vitro* and ultimately *in vivo*.

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