Institute for Bioprocessing and Analytical Measurement Techniques
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- Master thesis for 6 months -

Synthesis and conjugation of magnetic nanoparticles with proteins for blood platelet labeling

Tuning and modifying of magnetic nanoparticles (MN) with different shape and morphology conventional solvothermal and thermal decomposition methods are used.[1] Therefore high temperature and organic solvents as capping or oxidation agents are mandatory. A sustainable and moderate alternative represents the co-precipitation method in aqueous environment.[2] Especially in batch two iron oxide phases often are formed simultaneously if the conditions are not properly chosen. For better control of the relevant parameter microfluidic devices are suitable for this synthesis. The relevant biological impact of such MN manifested in their platelet labeling for visualization in vitro by magnetic resonance imaging. Platelet labeling efficiency is further enhanced when particles are conjugated with proteins like human serum albumin (HSA) and binding pathways of particles during platelet labeling has been determined.[3] However, the large distribution of binding forces between particle and platelet was observed while the aggregation of particles seems to occur which may impair platelets. This limitation may be due to the original characteristic of magnetic nanoparticles such as their shape/size, morphology and type of proteins conjugated on the surface of the particles.

Aim of the master thesis:

For further improvement of the platelet labeling, we aim to produce better quality of MN by narrowing size distribution, producing particles of different shapes, stabilize and coating them with different types of proteins. Therefore different synthesis strategies based on co-precipitation in aqueous environment will be performed.

Work packages of the master thesis:

- Synthesis magnetic nanoparticle (MN) in different size, shape, crystallinity, and morphology.
- Labeling of the appropriate magnetic nanoparticles with dextran to stabilize the particles and coated them with different proteins like human serum albumin (HSA) and fibronectin for the subsequent platelet labeling.
- Characterization of protein-MN particles by dynamic light scattering (DLS), Zetapotential, Scanning electron microscope (SEM) (for MN with a diameter of 100nm and more) and transmission electron microscopy (TEM) (in collaboration with the University of Mainz).

Profile of qualification and further requirements

Student of chemistry, biology, biochemistry or biotechnology with a strong tendency to work with technical platforms. Deadline for the application is 20.10.2019. It is possible to be financially supported by iba.

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[1] Kolhatkar et al. ACS Omega 2017, 2, 8010-8019.
[2] Y. Luengo, M. P. Morales, L. Gutiérrez, S. Veintemillas-Verdaguer J. Mater. Chem. C 2016, 4, 9482-9488.
[3] T-H. Nguyen, N. Schuster, A. Greinacher, K. Aurich *Appl. Mater. Interfaces* **2018**, 10, 34, 28314-28321.