

- Master Thesis for 6 months -

Microfluidic synthesis and functionalization of magnetic nanoparticles as multimodal probe with diagnostic relevance

In nanomedicine, magnetic nanoparticles (MN) have a tremendous potential cause by their low toxicity, superparamagnetic properties and simple separation technology.¹ Magnetite (Fe_3O_4) and Maghemite ($\gamma\text{-Fe}_2\text{O}_3$) attracted much attention in diagnostics and therapeutics.² Recently, by synthesis of MNs in microfluidics *via* continuous and segmented flow modes, we found an improvement of quality as compared with batch process. However, further efforts are required to reduce the size and size distribution of the particles. Beside strong magnetic properties, the functionalization with fluorescent dyes for imaging of cell uptake (particle tracking) and a biomarker for labeling of diseased cells (cancer, platelet dysfunction) *via* microfluidics is highly challenging.

Aim of the master thesis:

Based on synthesis protocols with batch and microfluidics the first part is the generation of MN with carboxymethyl-dextran and chitosan with the variation of reaction parameters to reduce size and improve the magnetic properties as well as biocompatibility. The MN quality will be proved *via* blood platelet labeling. The second part is the covalent coupling with different fluorescent dyes to track MN labeled breast cancer cells and blood platelets.

Work packages of the master thesis

- Microfluidic synthesis of different coated MN at different reaction conditions.
- Coupling of the MN with different fluorescence dye for particle tracking.
- Physicochemical characterization of the synthesized MNs by dynamic light scattering (DLS), confocal scanning electron microscope (CLSM) and in-situ infrared-spectroscopy (FT-IR)
- The magnetic properties included transmission electron microscopy (TEM), magnetic particle imaging (MPI, relaxivity) and x-ray based characterization (XPS) will be realized with collaborators (University of Mainz and nanoPET GmbH, Berlin).

Profile of qualification and further requirements

Student of chemistry, biology, biochemistry or biotechnology with a strong tendency to work with technical platforms and nanoparticles are encouraged to apply. **Deadline for the application is 31.03.2021.** It is possible to be financed by iba.

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References

1. Ali, A.; Hira Zafar, M. Z.; ul Haq, I.; Phull, A. R.; Ali, J. S.; Hussain, A., Synthesis, characterization, applications, and challenges of iron oxide nanoparticles. *Nanotechnology, science and applications* **2016**, 9, 49.
2. Ling, D.; Lee, N.; Hyeon, T., Chemical synthesis and assembly of uniformly sized iron oxide nanoparticles for medical applications. *Accounts of chemical research* **2015**, 48 (5), 1276-1285.