Chair of Bioseparation Engineering
TUM School of Engineering and Design
Technische Universität München

Master's Thesis

Magnetic-responsive Hydrogel for Bioseparation Applications

Keywords: Magnetic particles, hydrogel, streptavidin, biotin, magnetic force, cell isolation

Project Description

We are currently seeking a motivated and ambitious Master's Student in engineering to join our research project. The focus of this project revolves around the non-covalent interaction between streptavidin and biotin proteins, recognized as one of the strongest in nature (K_d 10^{-15}). This unique interaction, harnessed in conjunction with magnetic particles, enables the isolation of small biotinylated agents such as proteins and carbohydrates through magnetic force.

Our goal is to extend the application of this Streptavidin-Biotin Magnetic Particle (SBMP) system to isolate larger agents (>1 micrometer), such as bacterial cells. This expansion holds significant potential for enhancing the downstream of bioprocessing. However, a key challenge lies in adapting the system to accommodate the size differences.

To address this challenge, we hypothesize that immobilizing the SBMP on a supporting substrate with specific properties, such as porosity or tunable mechanical characteristics, could enhance the isolation efficiency. In this research project, you will play a crucial role in developing a proof-of-concept for immobilizing magnetic particles on the supporting substrate and subsequently detaching the particles via external stimuli.

Your responsibilities will include exploring topics such as the **surface modification** of the magnetic particles and the supporting substrates with avidin or biotin molecules, comparing sub-types of avidin (e.g., neutravidin, streptavidin) regarding their impact on the **interaction between magnetic particles and hydrogel**, or designing substrate properties to optimize interactions between particles and hydrogel.

Project Description

- Independent and scientific curiosity
- Willingness to learn the interdisciplinary fields (technical and knowledge supervision will be given)
- Student in the field of biotechnology, biochemical engineering, chemistry, or other relevant field

Start date: as soon as possible (contact Vincent Irawan @ v.irawan@tum.de

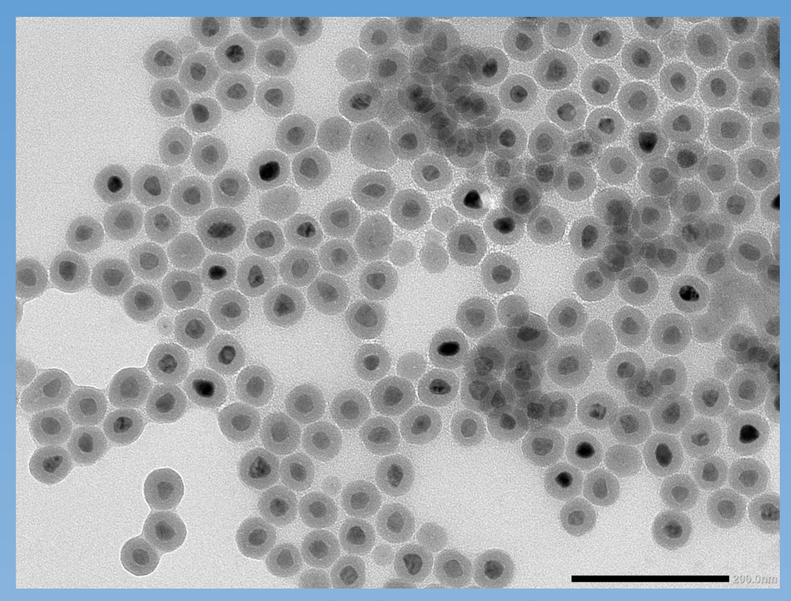

Figure 1. TEM Image of Silica-coated Magnetic Particles

Tasks

1. Surface modification of magnetic particles and hydrogel via chemical reactions or bioconjugation techniques.
2. Analytics of surface properties
   - Fluorescence microscopy and spectral analysis
   - Surface chemistry analysis
3. Protein analysis
4. Immobilization and detachment of magnetic particles-substrate.
5. Analysis of magnetophoresis

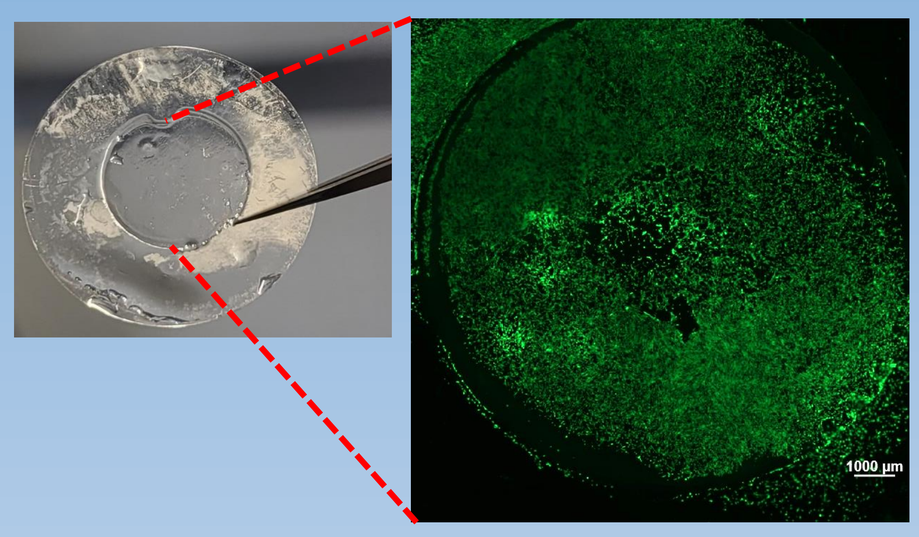

Figure 2. (left) small hydrogel attached on the cover slip (right) green-stained fibroblast cells attached on hydrogel

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