Chair of Bioseparation Engineering
TUM School of Engineering and Design
Technical University of Munich

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Bioseparation Engineering

Bachelor's/ Master's/Semester Thesis

Enzyme Immobilization on Magnetic Particles for IVT-Based mRNA Synthesis

Keywords: mRNA, In Vitro Transcription (IVT), Enzyme Immobilization, Magnetic Particles,

Project Description

Messenger RNA (mRNA) has become a cornerstone technology in modern biotechnology, accelerated by the COVID-19 pandemic and the breakthrough of mRNA vaccine technologies. Industrial mRNA production relies on in vitro transcription (IVT), a cell-free process, highly efficient but enzyme-intensive process based on T7 RNA polymerase.
As these enzymes are expensive and typically single-use, enzyme cost and sustainability are major bottlenecks. Covalent immobilization of IVT enzymes on magnetic particles offers a compelling solution, enabling rapid magnetic recovery, reuse, and significant cost reduction.
In this thesis, you will develop and characterize magnetic particle systems for the covalent immobilization of T7 RNA polymerase, including particle coating, immobilization studies, activity assays, and IVT analytics. The project is highly industry-oriented, conducted in close collaboration with an industrial partner in a fast-growing and impactful field of biotechnology.

Tasks

- Coating and functionalization of magnetic particles with suitable reactive groups
- Physicochemical characterization of coated magnetic particles (e.g. size, surface properties, magnetic behavior)
- Covalent immobilization of enzymes used in IVT, with emphasis on T7 RNA polymerase
- Systematic investigation of immobilization parameters (e.g. surface chemistry, enzyme loading, reaction conditions)
- Evaluation of immobilized enzyme activity using IVT reactions
- Comparison of free versus immobilized enzyme systems with respect to activity, stability, and reusability

Profile

- Enrolled in a Bachelor's or Master's program in Biotechnology, Chemical Engineering, Bioprocess Engineering, Bioengineering, or a related discipline
- Basic laboratory experience in biochemistry or molecular biology is advantageous
- Independent, structured, and motivated working style

Start: Flexible

We look forward to your application. Please include a current transcript of your academic records.

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