University of Bremen

UVT

The Research Group *Environmental Process Engineering* at the University of Bremen invites applications for a

PhD position in Engineering/Natural Sciences
Salary level 13 TV-L (100%)

within the project

Development of an MRI-based in-vivo method for the quantification of reactant gradients, mass transfer characteristics, and biomass growth in productive biofilms

funded by the German Research Foundation (DFG). The position is available at the next possible date and fixed-term for 3 years, subject to approval through the third-party funding.

Job description

Background:
Cupriavidus necator is a hydrogen-oxidizing bacterium, that can be used to produce bioplastics from CO_2. Growing in membrane biofilm reactors (Fig. 1), reactant gradients occur, limiting overall productivity. Knowledge of biomass density, pH and reactant (H_2, O_2) gradients as well as mass transfer characteristics inside such biofilms is one of the keys to identify limitation mechanisms and develop design and operation principles for optimized productivity.

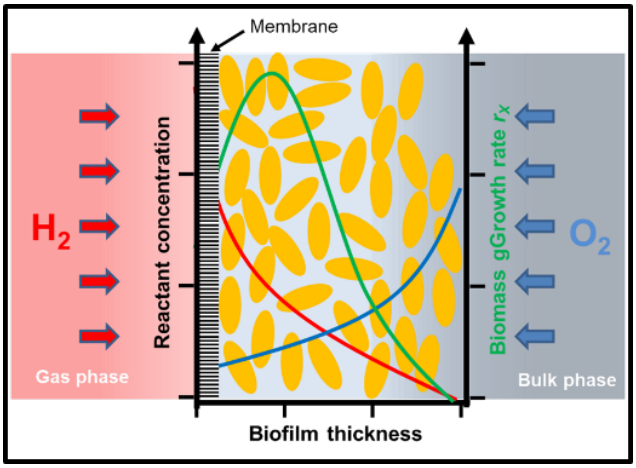

Fig. 1: For its growth, *C. necator* needs both hydrogen (supplied through the membrane) and oxygen (supplied from the bulk liquid phase). Your task is to develop an MRI-protocol to determine local reactant concentrations and bio-mass growth rate r_X. This will help to understand the limiting processes and optimize the design and operation of corresponding bioreactors.

The project:
Aim of this project is to further develop Magnetic Resonance Imaging (MRI) as an *in vivo/in situ* technique for investigating the spatial distribution of biomass density, mass transfer properties, substrate (O_2 and H_2) and pH gradients in biofilms and determine their influence on reaction rates and biomass growth. Using different MR techniques, the morphology as well as the spatially resolved pH, O_2 and H_2 concentrations within the biofilm will be characterized. Furthermore, locally resolved effective diffusion coefficients within the biofilm will be determined. In the end, we will expose the biofilms of *C. necator* to quorum sensing molecules and use our MRI method to dynamically investigate their effects on architecture and productivity as a function of local pH and oxygen conditions. The project is part of the DFG's Priority Programme "Productive Biofilm Systems" (SPP 2494) and the position is integrated into the Research Group *Environmental Process Engineering* (Prof. Dr.-Ing. S. Kerzenmacher). It will be co-supervised by Dr. E. Küstermann (*in-vivo MR*) and Dr. C. Roggatz (Research Group *Dynamic Ecological Chemistry*). Have a look at our websites to learn more about the exciting topics we are working on:

https://www.uni-bremen.de/en/uvt
https://www.uni-bremen.de/in-vivo-mr
https://www.uni-bremen.de/en/roggatz

Your tasks:

- Adaptation of an MR-compatible miniature bioreactor for the cultivation of *C. necator*
- Cultivation and maintenance of *C. necator* in the lab
- Development of an MR protocol that enables characterization of biofilms with respect to mass transfer, pH, reactant concentration and biomass density in a locally resolved manner
- Application of the developed protocol to experimentally characterize *C. necator* biofilms
- Development of a numerical model to extract locally resolved effective diffusion coefficients from the experimental data and to describe bacterial growth and reactant consumption based on bulk reactant concentrations
- Detailed analysis, verification and statistical assessment of measured data and parameters
- Supporting the research group to study overarching questions and with day-to-day laboratory tasks
- Preparation/ writing of scientific manuscripts for publication in internationally renowned journals and presentations and scientific exchange at conferences

We offer:

- An international and inter-disciplinary team with a collaborative spirit
- Specific training, networking and collaboration opportunities within the framework of the SPP2494 Productive Biofilm Systems
- Close supervision and mentoring to support you with your PhD project

Requirements

- Above-average academic university degree (M.Sc. or equivalent) in engineering, biology, physics, or a related field
- Keen interest in understanding both the fundamentals and applications of Magnetic Resonance Imaging (MRI)
- Solid experience in data analysis, programming (e.g. python) and simulation (e.g. COMSOL)
- Practical lab experience, preferably in the field of biology or chemistry
- Experience with microbiology and in culturing and handling bacteria would be of advantage
- Good English language skills in oral communication and writing of scientific reports (C1-level or comparable experience)
- Ambitious person who wants to drive this research project at the intersection of physics, biology, and engineering within an interdisciplinary team

How to apply

Please send your application documents until December 31st 2025 via email as one compiled pdf document to Prof. S. Kerzenmacher (kerzenmacher@uni-bremen.de). It should contain your ***Academic CV*** (including list of publications if applicable), ***copies of BSc/ MSc degree transcripts and certificates*** (as well as work references if applicable), the ***contact information for 2 referees***, and a ***Statement of Interest*** (1-page maximum) detailing specifically what motivated you to apply for the position, why you are interested in the proposed research topic and outlining your skills and experience that fit the post. For further information and in case of questions, please do not hesitate to contact Prof. Kerzenmacher directly using the above email address.

General hints

The university is family-friendly, diverse and sees itself as an international university. We therefore welcome all applicants regardless of gender, nationality, ethnic and social origin, religion/belief, disability, age, sexual orientation and identity. As the University of Bremen intends to increase the proportion of female employees in academia, women are particularly encouraged to apply. Disabled applicants will be given priority if their professional and personal qualifications are essentially the same. Please note that any costs related to applications and interviews cannot be refunded.