

2025-2026 Internship proposal at LMGP Lab.

Protein adsorption on mesoporous silica-functionalised papers

Context

The research groups Smart membranes and Macromolecular and Paper Chemistry at TU Darmstadt (<https://www.chemie.tu-darmstadt.de/map/index.en.jsp> // https://www.chemie.tu-darmstadt.de/brunsen/smart_membranes_the_group/index.en.jsp) develop together with the startup company CeraSleeve (<https://www.cerasleeve.com/>), smart paper coatings to optimize physical properties such as wet-strength for example in a sustainable way avoiding plastics. The coatings are based on sol-gel chemistry applied to the paper fibres. The porosity of these coatings can be tuned to finely control paper properties.

The IMBM team at the laboratory for Material Sciences and Physical Engineering (LMGP, <http://www.lmgp.grenoble-inp.fr/>) at the Grenoble Institute of Technology analyses surface adsorption of proteins and other molecules on different materials to understand the correlations between physico-chemical properties of material surfaces and molecular adsorption profiles.

A research collaboration within the framework of Unite! is initiated to work on protein adsorption on mesoporous as well as dense silica-functionalised papers.

Project description

In this collaborative project, the objective is to explore protein adsorption as a function of the properties of silica-based coatings on CeraSleeve papers. Protein adsorption is of high relevance in the context of paper sensor, design of cascade reactions or paper membrane separation.

To understand protein adsorption on silica modified papers, silica-paper hybrid materials with varying wet-strength and wettability and with varying porosity will be fabricated at TU-Darmstadt and provided for protein adsorption analysis. Silica-functionalized papers are characterized regarding the silica content and its structural properties using advanced characterisation techniques. Tensile measurements are conducted to analyse the mechanical properties, i.e. dry and wet-strength of the modified papers. Fluorescence microscopy can be used to investigate silica distribution or protein distribution. The fibre composition (from hardwood and/or softwood) of the paper substrates, as well as grammage, can be varied/adjusted. As reference material the mesoporous silica will be provided as thin film deposited on glass or silicon wafer substrates for example.

Protein adsorption will be quantified by incubating the selected papers with protein solutions in appropriate conditions. The increased effective surface area of the coated papers can be exploited to indirectly measure protein adsorption by quantifying the lost fraction in the solution. Protein adsorption as a function of porosity of silica coatings will be explored using selected proteins of different masses/hydrodynamic radii. If time allows, direct adsorption measurements using surface sensitive techniques such as quartz crystal balance can also be explored to analyse protein adsorption directly on silica thin films.

Scientific environment

LMGP (Laboratory of Materials Sciences and Physical Engineering) is a joint research unit (UMR 5628) of CNRS and Grenoble INP within Université Grenoble Alpes, located at the Minatec site in the PHELMMA (Physics, Electronics, Materials) engineering school buildings. The IMBM group at LMGP has developed expertise in protein-material interactions addressing applications such as therapeutic protein stability, material surface fouling/ antifouling strategies and protein-based adhesives. Laboratory website: LMGP (<http://www.lmgp.grenoble-inp.fr/>)

Profile & requested skills

We look for a highly motivated student with a very good background in protein biochemistry. Previous experience with enzyme catalysis and fluorescence spectrophotometry or interface sensitive techniques is a plus but not absolutely essential. The student should have excellent communication skills and team work capabilities which are essential in the collaborative context of the project. Good writing and presentation skills in English are required.

Contacts

Interested candidates should send a CV and motivation letter to Prof Marianne WEIDENHAUPT (marianne.weidenhaupt@grenoble-inp.fr)

Gratification

The student will receive a monthly allowance of 567€/month financed by the Unite! university alliance program. (<https://www.unite-university.eu/>)