ITI HiFunMat Master Internship Proposal

☐ M 1 ☒ M 2

Title Understanding the Interactions between Bio-based Polyelectrolytes and Bacterial Functional Amyloids

Internship supervisor

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Collaboration with a HiFunMat member (*please indicate their name*)	☐ No ☐ Yes :

Student profile looked for

Master program (*more than one box can be ticked)*	☒ Material science and engineering ☒ Chemistry ☐ Physics
Other indications if necessary	

Internship description

Amyloids have conventionally been associated with protein misfolding disorders in both humans and animals [1]. However, over two decades of research have unveiled the intriguing prevalence of amyloids in diverse bacterial and fungal species, serving multifaceted functions such as biofilm structural components, toxins, epigenetic material, and adhesins mediating interactions with host cells [2]. Recent research on bacterial functional amyloids has sparked interests in leveraging amyloid fibrils (AFs) as potential targets for developing antibacterial compounds and materials, with a particular focus on inhibiting biofilm formation. Biofilms play a pivotal role in bacterial infections by providing protection against host immune responses and antimicrobial agents. Consequently, targeting AFs as a means to inhibit biofilm formation becomes imperative. The primary objective of this study is to elucidate the intricate molecular interactions between AFs and bio-based polyelectrolytes, which are capable of inhibiting or interfering with amyloid fibrillation. Of particular interest in this study are functional amyloids from *Staphylococcus aureus* and *Pseudomonas aeruginosa,* two biofilm-forming organisms commonly implicated in healthcare associated infections. An array of microscopy and spectroscopy techniques will be employed to investigate the assembly and disassembly (by polyelectrolytes) dynamics of AFs derived from the target organisms. Furthermore, the physicochemical and mechanical properties of these AFs will be characterized. These characterizations will yield invaluable insights into the molecular mechanisms underlying the interactions between polyelectrolytes and AFs, encompassing critical aspects such as aggregation kinetics and the stability of aggregates. The overarching goal is to identify anti-amyloidogenic polyelectrolytes, paving the way for the development of anti-biofilm surface coatings.

1. Hawthorne, W., Rouse, S., Sewell, L. and Matthews, S.J., 2016. Structural insights into functional amyloid inhibition in Gram− ve bacteria. *Biochemical Society Transactions*, *44*(6), pp.1643-1649.
2. Van Gerven, N., Van der Verren, S. E., Reiter, D. M., & Remaut, H. (2018). The role of functional amyloids in bacterial virulence. *Journal of molecular biology*, *430*(20), 3657-3684.