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Nanostructured metal-organic frameworks (MOFs) as bactericidal materials for sustainable applications

Master project/internship/thesis with a duration of 6 months

Location: Division of Systems and Synthetic Biology, Department of Biology and Biological Engineering, Chalmers University of Technology

Supervisor and examiner: Dr. Zhejian Cao and Prof. Ivan Mijakovic

Time to start: As soon as possible

Background: Antibiotic resistance is regarded as one of the biggest threats to global health according to the World Health Organization (WHO)[1]. Designing novel materials with different bactericidal mechanisms[2], therefore, is of commercial and scientific desire. Considering the size of bacteria (~1 μm) and the thickness of their lipid membrane (~5 nm), nanomaterials with sharp structure features can be promising candidates for antimicrobial applications with a physical cutting mechanism. Metal-organic frameworks (MOFs) are emerging porous materials with a crystalline structure and flexible functionality in their organic linkers[3]. With a nanoscale particle size, designable geometry, and tailorable chemical composition, MOFs demonstrate great potential for a physical bactericidal function. Moreover, MOFs can potentially load drugs (e.g., natural quorum sensing inhibitors) to achieve a synergetic antibacterial and antifouling effect. This study will pioneer the field of using nanostructured MOFs as bactericidal materials for sustainable applications, including wound healing, and marine antifouling. This project is an interdisciplinary work, offering experience in biology, chemistry, and materials science.

The aim of the project: This project will be carried out in Chalmers SysBio lab. Different MOFs will be verified with their antibacterial performance in comparison to the benchmark materials. Various substrates from the silicon wafer to commercial bandage will be tested as the matrix for the nanostructured MOFs.

What will you do/learn?

- Evaluation of antibacterial performance by colony-forming unit (CFU) counting and fluorescence microscopy
- MOF coating on different substrates
- Materials characterization, including scanning electron microscopy (SEM), Transmission electron microscope (TEM), X-ray diffraction (XRD), etc.

About you

- Enrolled in a master program relevant to biology/chemistry/materials science
- Enjoy science and learning new things with strong motivation
- Good at teamwork and collaboration

How to apply?

Please send an application email to zhejian@chalmers.se with your CV

More information: www.sysbio.se; www.jerrylab.com

[1] Antibiotic resistance. https://www.who.int/news-room/fact-sheets/detail/antibiotic-resistance.

[2] Pandit, S. et al. Adv. Mater. Interfaces 5, 1701331 (2018).

[3] Öhrström, L. & Amombo Noa, F. M. Metal-Organic Frameworks. DOI: 10.1021/acs.infocus.7e4004.