ExMI EXPERIMENTAL MOLECULAR IMAGING
HELMHOLTZ INSTITUTE FOR BIOMEDICAL ENGINEERING
RWTH
CHAIR OF EXPERIMENTAL MOLECULAR IMAGING – MEDICAL FACULTY
Director: Prof. Dr. Fabian Kiessling, M.D.

Dr. med / M. Sc. Thesis Project

Metal-Organic Framework Nanoparticles for Cancer Radio-Immunotherapy

Description of the project: Metal-organic frameworks (MOF) are a class of metal-based materials that are being explored for cancer therapy[1]. They offer an extremely diverse range of properties thanks to their metal-based chemistry, with potential to enhance the radiation therapy efficacy and engage the immune system to attack cancer.[2] In this project, we aim to explore the underlying biological mechanisms that drive this MOF-enhanced radiotherapy.

We are looking for a highly motivated biomedical engineering / medicine / chemistry student to carry out an interdisciplinary Master's thesis project at the interface between metal-based nanostructures and cancer immunotherapy. The focus of the work will be to elucidate interactions between MOFs and the immune system at the cellular level. The applicant will join an active and international lab (Department of Nanomedicine and Theranostics, headed by Prof. Twan Lammers[3]), at the Center for Biohybrid Medical Systems (CBMS, ExMI, UKA Aachen), and collaborate with colleagues from the Department of Immunology (Prof. Lothar Rink, UKA Aachen[4]) and the University of Texas at Dallas (Prof. Jeremiah Gassensmith[5]).

Research tasks will involve (i) assessing the in vitro toxicity of various MOF structures in cancer and immune cells along with their (ii) underlying cell death mechanisms. They will then (iii) explore the combination of MOFs and radiotherapy through in vitro 2D and 3D assays. Through this project, the applicant will gain experience with in vitro cell culture, practical cancer immunology and work with an exciting new class of materials that is just beginning to make an impact on the biomedical field.

Profile: Highly motivated, broadly interested and internationally oriented, with background in biomedical engineering, chemistry or medicine. For medical students, a 6-month scholarship (750 Euros / month) is available via DFG funding.

Contact: For further information, please contact us via email: Dr. Quim Peña (jpena@ukaachen.de) and Alec Wang (awang@ukaachen.de). Website: www.exmi.rwth-aachen.de

References:

1 Ettlinger, R., Peña, Q. & Wuttke, S. Nano-to-Macroscale Reticular Materials to Address Societal Challenges. *Advanced Functional Materials* **34** (2024).

2 Wang, A. *et al.* Biomedical Metal–Organic Framework Materials: Perspectives and Challenges. *Advanced Functional Materials* **34**, 2308589 (2024). https://doi.org:https://doi.org/10.1002/adfm.202308589

3 Wang, B. *et al.* Potent and Prolonged Innate Immune Activation by Enzyme-Responsive Imidazoquinoline TLR7/8 Agonist Prodrug Vesicles. *Journal of the American Chemical Society* **142**, 12133-12139 (2020). https://doi.org:10.1021/jacs.0c01928

4 Wessels, I., Fischer, H. J. & Rink, L. Dietary and Physiological Effects of Zinc on the Immune System. *Annual Review of Nutrition* **41**, 133-175 (2021). https://doi.org:https://doi.org/10.1146/annurev-nutr-122019-120635

5 Luzuriaga, M. A. *et al.* Enhanced Stability and Controlled Delivery of MOF-Encapsulated Vaccines and Their Immunogenic Response In Vivo. *ACS Applied Materials & Interfaces* **11**, 9740-9746 (2019). https://doi.org:10.1021/acsami.8b20504