Nano- and microscale NMR microscopy using NV-centers in diamond

Dominik B. Bucher[1]

[1]Technical University of Munich, Munich, Germany,

Nitrogen vacancy (NV) point defects in diamond have become a promising platform for magnetic resonance microscopy. The electronic spin state of these solid-state spin system can be optically polarised, coherently manipulated with microwave pulses, and read out via their spin-state-dependent photoluminescence. Using the optically detected spin state readout, NMR signals can be detected with unprecedented sensitivity [1]. In the first part of my the talk, I will give a short tutorial on NV-based NMR spectroscopy. In the second part, I will give an overview over our recent work on spatially resolved NV-NMR: 1) Nanoscale NV-NMR to detect monolayers of self-assembled molecules on an alumina oxide surface and their formation in real time under chemically relevant conditions [2]. 2) Combination of pulsed field gradient spin echo (PGSE) experiments with NV-NMR to quantify molecular diffusion and mobility within microstructures [3]. 3) Wide-field optical NMR microscopy on a camera [4]. This technique allows magnetic resonance imaging in real space on microscopic length scales. The remaining obstacles to this novel technologies and future goals are discussed in the final part.

References: [1] Allert, Chem Comm (2022). [2] Liu, PNAS (2022). [3] Bruckmaier, Science Advances (2023). [4] Briegel, Nature Communications (2025)