

# GRK 2516 Soft Matter Seminar

April 28, 2022 at 3:30 p.m.  
Minkowski Room, 05-119, Staudingerweg 7

Research seminar of the DFG Research Training Group GRK 2516 (<https://grk2516.uni-mainz.de>).

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## Hydrogel Dehydration under Oil Flow

Hydrogels are present in many medical and consumable products for their capability to hold water under a range of externally imposed stresses (e.g., mechanical). Here, we investigate the stability of two types of hydrogel coatings (thermoresponsive (poly-N-isopropylacrylamide, PNIPAm) and weakly charged (poly (acryl acid), PAA)) by steadily streaming silicone oil over them both, experimentally and numerically. We find that independent of the hydrogel's polymer properties or the flow conditions, the swollen coating depletes linearly over time. The linearity of the depletion indicates that diffusion drives water molecules from the hydrogel into the oil flow. However, process timescales indicate that water is not provided instantaneous: Water molecules are retained in the hydrogel, leading to a local non-equilibrium at the shared interface which throttles depletion. We model the molecule flux over the interface, using Kramers' theory, and implement the obtained (thermal) non-equilibrium flux in mean-field framework, which we solve numerically. Results of our simulation and experiments do match, well. These findings let us deduce that depletion is unaffected by the properties of the hydrogel (charge, elasticity, etc.) but only a consequence of the chemical potential of water and the flowing silicone oil. Depletion can be tuned by matching chemical potentials between water and silicone to avoid depletion.