Microgels as stabilizers for foams: A multiscale approach

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Foams appear in many applications such as in personal care products, firefighting and food technology. An elegant tool to tune the foam stability is the addition of polymers of different charge, amphiphilicity or molecular architecture. An example, which will be addressed here are foams which are stabilized by stimuli-responsive microgels.
For understanding macroscopic foam properties, it is important to get deeper insight into the different length scales, *i.e.* the structuring of microgels at the *air/water interface*, in *foam films*, which separate the *air bubbles* from each other and (macroscopic) *foams*.
The presentation will focus on microgels based on Poly-N-isopropylacrylamid (PNIPAM). Their stiffness and deformation at the air/liquid interface is controlled by the amount of cross-linker content which dominates the lateral pattern formation at the liquid interface. A challenge for studies of microgel-stabilized foam films are their massive inhomogeneities, which makes it difficult to measure the respective foam film thickness. To get insight into foam film properties, we use a camera based thin film pressure balance to study microgel-stabilized foam films in terms of disjoining pressure inside the foam films, drainage kinetics, and foam film stability [1, 2]. Film thickness profiles give insights into particle bridging, agglomeration and network formation in the foam films. A correlation is shown with the mechanical properties of the microgels as determined by atomic force microscopy (AFM) nanoindentation measurements. For a complete picture, small angle neutron scattering (SANS) measurements on macroscopic foams provide additional insights into the link between foams and single foam films [1, 3, 4].

Keywords: Foams, foam films, SANS. thin film pressure balance; AFM nanoindentation, microgels.

References

[1] M. Kühnhammer, K. Gräff, E. Loran, O. Soltwedel, O. Löhmann, H. Frielinghaus, R. von Klitzing*, *Soft Matter*, 18, 9249 - 9262, **2022,** DOI: 10.1039/D2SM01021F
[2]https://download.hrz.tu-darmstadt.de/media/FB05/SMaI/V0011_Microgel_Foam_Films_KG_v2.mp4
[3] M. Kühnhammer, L. Braun, M. Ludwig, O. Soltwedel, L. Chiappisi, R. von Klitzing*, *Journal of Applied Crystallography*, 55, 758, **2022**, DOI: 10.1107/S1600576722004691
[4] M. Kühnhammer, T. Widmann, L. P. Kreuzer, A. J. Schmid, L. Wiehemeier, H. Frielinghaus, S. Jaksch, T. Bögershausen, P. Barron, H. Schneider, A. Hiess, P. Müller-Buschbaum, T. Hellweg, R. von Klitzing*, O. Löhmann. *Applied Sciences*, *11*, 5116-5128, **2021**. DOI: 10.3390/app11115116