CPP 33: Complex Fluids, Colloids, Micelles and Vesicles II

Time: Wednesday 10:00–11:15 Location: ZEU/LICH

Invited Talk CPP 33.1 Wed 10:00 ZEU/LICH

Shape-induced superstructure formation in concentrated ferrofluids — •Sabrina Disch — University of Duisburg-Essen, Essen, Germany

The response of magnetic nanoparticles to applied static and dynamic magnetic fields is the subject of intense research in view of its fundamental technological importance [1]. The field-assisted self-organization of shape-anisotropic nanoparticles in dispersions is particularly desired for liquid crystalline or optically anisotropic materials and as a prerequisite for self-organization into long range ordered arrangements [2]. A strong structure-directing influence of the particle shape on the symmetry of mesocrystalline arrangements has been established for nanocubes with a varying degree of cubicity [3].

In this contribution, we give a detailed account on the impact of nanoparticle shape and size on the interparticle correlations in colloidal dispersions of maghemite nanoparticles. Despite the similar particle size, magnetic moment, and volume concentration (>5 vol-%), we observe a significantly distinct aggregation behavior of nanospheres and nanocubes using small-angle neutron scattering [4]. The field-dependent arrangement of cuboidal nanoparticles into mesocrystalline assemblies and their geometric orientation will be discussed as observed by field-dependent small-angle scattering experiments.

[1] Q. A. Pankhurst et al., J. Phys. D: Appl. Phys. 36, R167 (2003).
[2] S. Disch, E. Wetterskog et al., Nano Letters 11, 1651 (2011).
[3] E. Wetterskog, S. Disch et al., Nanoscale 8, 15571 (2016).
[4] P. Bender, S. Disch et al., J. Appl. Cryst. 55, 1613 (2022).

CPP 33.2 Wed 10:30 ZEU/LICH

Modeling artificial cells to control the local chemical environment — •Nils Göth and Joachim Dzubiella — Applied Theoretical Physics—Computational Physics, Physikalisches Institut, Albert-Ludwigs-Universität Freiburg, 79104 Freiburg, Germany

Living cells change and respond to their environment. Synthesized artificial cells (hollow microgels) show in experiments pH-responsive behavior by a pH-dependent membrane permeability and change their pH-environment by a chemical reaction [1]. Here, we report a simple model for such artificial cells based on the feedback mechanism between permeability and pH. We introduce the model on the basis of recent experiments [1] and study the effects of experimentally tunable parameters. The model captures not only the effects observed in the experiments, but further predicts the behavior of mixtures of two different kinds of artificial cells. Thus, we provide guidance for future experiments in the field of collective behavior of artificial cells.

[1] Krehan et al., Chem 11, 102409 (2024).

CPP 33.3 Wed 10:45 ZEU/LICH

Evaporation-driven assembly of colloidal monolayers and multilayers — •Qingguang Xie[1] and Jens Harting[1,2] — [1]Helmholtz-Institut Erlangen-Nürnberg for Renewable Energy (IET-2), Forschungszentrum Jülich, Erlangen, Germany — [2]Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany

Drying of colloidal suspension films is a common approach to synthesize colloidal monolayers and multilayers for applications such as photovoltaics and catalysis. The fundamental understanding of the complex processes involved in film drying is essential for controlling and optimizing the deposition structure. We numerically investigate the drying dynamics of both thin and thick colloidal suspension films. For thin films, we focus on the influence of substrate and particle wettability on assembled monolayers. High substrate wettability promotes hexagonally packed monolayers, while low wettability leads to droplet formation and particle clustering. Furthermore, we reveal that higher particle wettability can mitigate the impact of substrate wettability and facilitate the formation of highly ordered monolayers. We propose theoretical models predicting the surface coverage fraction dependent on particle volume fraction, initial film thickness, particle radius, as well as substrate and particle wettability, and validate these models with simulations. In a further step, we investigate the drying of thick films with different particle-particle interactions. Weak interactions led to densely packed structures, while strong interactions led to more porous structures due to aggregation.

CPP 33.4 Wed 11:00 ZEU/LICH

Microscopic liquid marbles for force sensing using AFM — •Tomas P. Corrales[1], Constanza Rodriguez[1], Catalina Navarrete[1], Diego Cortés[2], Michael Kappl[2], and Syuji Fujii[3] — [1]Universidad Tecnica Federico Santa Maria — [2]Max-Planck-Institut für Polymerforschung, Mainz, Germany — [3]Osaka Institute of Technology, Osaka, Japan

An AFM cantilever is an exceptional tool for measuring friction and adhesion forces at the nanoscale. We have recently shown the possibility of fixing microscopic liquid droplets on the end of a tipless AFM cantilever, which was used to measure friction forces of a Teflon surface (D. Cortes et al., Physical Review Letters 135, 048203, 2025). In this new work, we have set out to extend this approach by fixing microscopic liquid marbles at the end of an AFM cantilever. Liquid marbles are prepared from hydrophobic nanoparticles of CaCO3. We first spray a mixture of water glycerol over a powder of these CaCO3 nanoparticles, which creates a collection of microscopic liquid marbles. Afterwards, we attach these droplets to a hydrophobic tipless AFM cantilever with a hydrophilic sticky point. With this system we explore liquid marble friction, adhesion and stability.