NONEQILIBRIUM PHENOMENA IN SOFT CONDENSED MATTER (SYNP)

Jointly organized by
Chemical and Polymer Physics (CPP)
Dynamics and Statistical Physics (DY)
Biological physics (AKB)

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Soft condensed matter involves many nonequilibrium phenomena, such as for instance structural phase transitions, the reorientation dynamics of block copolymer meso-structures and liquid crystals, spreading and dewetting of complex fluids, and fracture of thin soap films. In recent years large progress has been made in observing these phenomena with novel microscopy techniques and modeling their dynamics with large-scale computer simulations. Nevertheless, nonequilibrium phenomena often lack a thorough theoretical description. This one-day symposium will provide a forum to discuss the latest experiments, computer simulations, and theories.

OVERVIEW OF INVITED TALKS AND SESSIONS

(lecture room HSZ 04)

Invited Talks

SYNP 1.1	Tue	09:30	(HSZ 04)	**Rising plumes, layering transitions and squeeze-out patterns in soap films**, Steffen Berg, Sandra M. Troian
SYNP 1.2	Tue	10:00	(HSZ 04)	**Computer simulation of block copolymers under external fields**, A.V. Zvelindovsky
SYNP 2.1	Tue	11:00	(HSZ 04)	**The dynamics of a moving wetting line: a review**, Joël De Coninck
SYNP 2.2	Tue	11:30	(HSZ 04)	**Droplet pinch off of diluted polymer solutions**, Christian Wagner
SYNP 2.3	Tue	12:00	(HSZ 04)	**Equilibrium and non-equilibrium phenomena in complex food systems**, Raffaele Mezzenga

Sessions

SYNP 1	**Noneqilibrium Phenomena in Soft Condensed Matter**	Tue 09:30–10:30	HSZ 04	SYNP 1.1–1.2
SYNP 2	**Noneqilibrium Phenomena in Soft Condensed Matter**	Tue 11:00–12:30	HSZ 04	SYNP 2.1–2.3

Related sessions in Section CPP

CPP 8	**SYMPOSIUM: Noneqilibrium Phenomena in Soft Condensed Matter**	Tue 14:00–16:45	ZEU Lich	CPP 8.1–8.10
CPP 10	**POSTER: Noneqilibrium Phenomena in Soft Condensed Matter**	Tue 17:00–19:00	P3	CPP 10.1–10.11

Sessions

– Invited Talks –

SYNP 1 Noneqilibrium Phenomena in Soft Condensed Matter

Time: Tuesday 09:30–10:30 Room: HSZ 04

Invited Talk SYNP 1.1 Tue 09:30 HSZ 04

Rising plumes, layering transitions and squeeze-out patterns in soap films — •Steffen Berg[1,2] and Sandra M. Troian[1] — [1]Dept. of Chemical Eng., Princeton University, Princeton, NJ, USA — [2]Shell International Exploration and Production B.V., Kesslerpark 1, 2288 GS Rijswijk (ZH), The Netherlands

In free-standing *microscale* soap films containing surfactant micelles an instability near the film borders creates moving patterns that resemble rising "lava plumes" [1]. Our recent studies indicate that these moving patterns contribute to the drainage dynamics as a rate-determining mechanism impacting on the scaling exponent of the film thickness as function of time $h(t)$ [2]. Aqueous *nanofilms* comprised of micelle-polymer complexes under confinement reveal two novel instabilities linked to the degree of association. The first, triggered by the final thinning transition, generates constant growth fractal patterns whose dimension correlates with the bulk viscosity. A mapping to the Saffman-Taylor instability [3] reveals the critical viscosity contrast for phase segregation. A secondary instability for high polymer molecular weights causes the fractal phase to self-assemble into a macroscopic array of flattened nanodroplets with distinct 4-fold packing symmetry.

[1] K. J. Mysels, K. Shinoda and S. Frankel *Soap Films, Studies of Their Thinning*; Pergamon Press: New York, 1959.
[2] S. Berg, E. A. Adelizzi and S. M. Troian, Langmuir **21**, 3867 (2005).
[3] P. G. Saffman and G. I. Taylor, Proc. Roy. Soc. London, Ser. A **245**, 312 (1958).

Invited Talk SYNP 1.2 Tue 10:00 HSZ 04

Computer simulation of block copolymers under external fields — •A.V. Zvelindovsky — Centre for Materials Science, Department of Physics, Astronomy & Mathematics, University of Central Lancashire, Preston, PR1 2HE, United Kingdom

Physics of micro-phase separation in various block copolymer systems is investigated by means of dynamic self-consistent field simulation. The emphasis of this talk will be given on dynamics of systems subjected to external fields. Several examples will be discussed. The first example gives a picture of dynamic rearrangement of various structures (lamellar, hexagonally packed cylinders, spherical micelles) in the applied electric field. The second is illustrating kinetics of surface phase transitions in confined systems (thin films). Next, we discuss micro-phase transformation under temperature change. Results on soft confinement (vesicle formation and membrane fusion) will be reported as well.

SYNP 2 Noneqilibrium Phenomena in Soft Condensed Matter

Time: Tuesday 11:00–12:30 Room: HSZ 04

Invited Talk SYNP 2.1 Tue 11:00 HSZ 04

The dynamics of a moving wetting line: a review — •Joël De Coninck — University of Mons-Hainaut, 20 Place du Parc, 7000 Mons, Belgium

This talk will be devoted to a review of the recent results concerning the dynamics of wetting on different types of substrates: flat surfaces, fibres, pores ... Combining theoretical approach, experimental results and large scale molecular simulations, it will be shown that the dynamics of moving wetting line can be related to the equilibrium properties of the constituents, to the friction between the liquid and the solid surface, to the viscous bending of the meniscus, ... many different contributions to a mechanism which is still not completely elucidated despite its considerable importance in practice.

Invited Talk SYNP 2.2 Tue 11:30 HSZ 04

Droplet pinch off of diluted polymer solutions — •Christian Wagner — Institut für Experimentalphysik, Universität des Saarlandes, D-66123 Saarbrücken

Tiny amounts of polymers can alter the flow behaviour of simple liquids dramatically. An aesthetic and instructive example is the detachment process of a droplet of a polymer solution, e.g. a diluted DNA solution. It is characterized by the suppression of the pinch off finite time singularity and the formation of a cylindrical filament between the droplet and the nozzle. On later stages of the experiments beads on a string a formed. Their generation can be well explained with scaling arguments of the intrinsic time scales of the experiment. The dramatic increase of resistance against the flow is macroscopically described by the elongational viscosity. It is a crucial parameter in many different industrial processes where contraction flows are generic. A pure elongational flow stretches the macromolecules at maximum and we use different experimental techniques simultaneously to relate macroscopic flow profiles with microscopic polymer configurations.

Invited Talk SYNP 2.3 Tue 12:00 HSZ 04

Equilibrium and non-equilibrium phenomena in complex food systems — •Raffaele Mezzenga — University of Fribourg and Nestlé Research Center, Switzerland

Complex food systems, as any other soft-condensed matter material, exhibit a behaviour, whose thermodynamic nature is intimately related to the relevant length scale considered. Since foods are structured over a broad range of different typical length scales, very different kinetics to attain their equilibrium configuration are encountered. If correlation length scales are small, very short times are needed to re-organize molecules to attain equilibrium, while if correlation length scales are large, very slow kinetics will be followed. This explains why, for examples, foams, where length scales reach the order of millimeters, can be stable for long times despite their high internal energy associated with the presence of very large interfaces, whereas self-assembled liquid crystalline foods, whose typical feature size is of the order of few nanometers, are almost always observed at the equilibrium. In the present talk we consider a few selected examples of foods in which the equilibrium/non equilibrium nature can be directly related to the typical length scale of the structure and we will discuss the current understanding of the physics ruling their macroscopic behaviour.