SoftComp
SOFT MATTER COMPOSITES
Network of Excellence

www.eu-softcomp.net

newsletter
No. 12 · 2014

Editorial

SoftComp celebrated its 10th Anniversary in 2014! The Consortium started as the EU Network of Excellence for Soft Matter Composites with 24 academic and industrial partner institutions. It has grown up to 36 participating institutions. During the last year, we were very happy to welcome three new groups (details see page 7). This shows that SoftComp has become an important and recognized collaboration network in Soft Matter Science in Europe. We would like to emphasize that the network is open for the accession of new partners. In particular, we would be very happy to strengthen the expertise in biophysics, biomedicine and biotechnology.

The current newsletter features "active matter" as an area of Soft Matter science, which has grown rapidly in recent years. Two articles provide a glimpse into this exiting field. The first article highlights the insights of bacterial motility and collective behavior by considering them as active colloids, i.e. by bringing soft matter concepts to bear on biological systems. The second article emphasizes the importance of computer simulations to understand the dynamical and cooperative behavior of microswimmers and self-propelled particles.

The first two SoftComp topical workshops have taken place in 2014, and have been received very well. We are very happy to announce two new topical workshops in 2015, see page 7. The idea of the topical workshops is to focus on topics of particular interest to the network, but to be open to all interested researchers. Topical workshops are organized jointly by at least two SoftComp partners.

The 4th International Soft Matter Conference, ISMC will take place in in Grenoble (France) from 12 - 16 September 2016. First announcements will be distributed by mid 2015.

The announced newsletter-microsite – aiming at an additional interactive communication to the printversion of the newsletter – will be available at April first 2015. Use the following link: ***www.eu-softcomp.net/news/newsletter-microsite***

„In the days of the tragic events around Charlie Hebdo, we would like to express our sincere sympathy with friends and colleagues in France on behalf of the SoftComp community. This concerns all of us, beyond the humanitarian aspects, because the freedom of speech is indispensable for science."

Hugo Bohn & Gerhard Gompper

In This Issue

Bacteria as Active Colloids

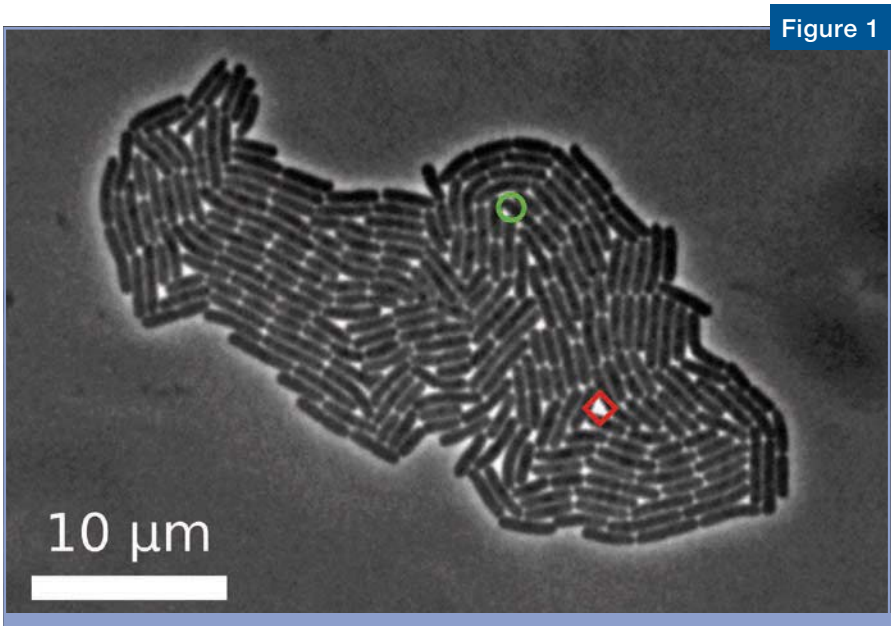
Wilson Poon – SoftComp partner: School of Physics & Astronomy, The University of Edinburgh

The majority of bacteria have sizes in the 0.2-2 µm range, so that they are colloids, i.e. particles that are suspended against gravity by thermal motion. Indeed, founders of colloid science such as Sir Eric Rideal (1890-1974) had studied the colloidal aspects of bacteria, especially their surface properties [1]. Noted colloid scientists continue to contribute; see, e.g., Johannes Lyklema's widely-cited study of the adhesion of bacterial cells to surfaces [2].

Bacteria have recently captured the attention of soft matter scientists in a new way: they have become experimental paradigms for the emerging field of active matter, the study of intrinsically non-equilibrium many-body systems in which the basic entities continually dissipate energy [3]. Thus, bacteria are active colloids; these 'living particles' dissipate energy to grow and divide, and sometimes swim. Here I give an overview of some current Edinburgh work in these areas led by Rosalind Allen, Mike Cates, Davide Marenduzzo, Alexander Morozov, Bartek Wacław and myself. A wider-ranging review is available [4].

Growing and making copies of itself is, of course, a fundamental characteristic of living organisms. Bacteria demonstrate the simplest version of this intrinsically non-equilibrium process. In an experiment that could in principle have been done by Louis Pasteur (1822-1895), the father of modern microbiology, *Escherichia coli* bacteria embedded in agar under a glass coverslip are observed in a microscope to grow into an initially two-dimensional (2D) colony, as these 1µm x 2 µm spherocylindrical hard rods repeatedly double and divide. Under constant external conditions, the colony shapes are statistically reproducible, and can be used for identifying strains. Such reproducibility suggests that there is physics to be done. A recent Cambridge-Edinburgh collaboration has found [5] that the 2D colony displays a buckling instability once it reaches a critical size. The suggestion is that such buckling into the third dimension is governed largely by the friction between the growing colony and nearby conning surfaces. We are now analysing bacterial colonies as 'active nematic liquid crystals'. Soft matter scientists have long used synthetic colloidal rods to model liquid-crystalline behaviour; a growing

Figure 1



A 2D colony of *E. coli*, with a -1/2 (◇) and a +1/2 defect (○) highlighted. Courtesy of Dario Dell'Arciprete.

Bacteria as Active Colloids (continued)

Wilson Poon – SoftComp partner: School of Physics & Astronomy, The University of Edinburgh

bacterial colony offers an active version, showing, e.g. well-known defects, Fig. 1.

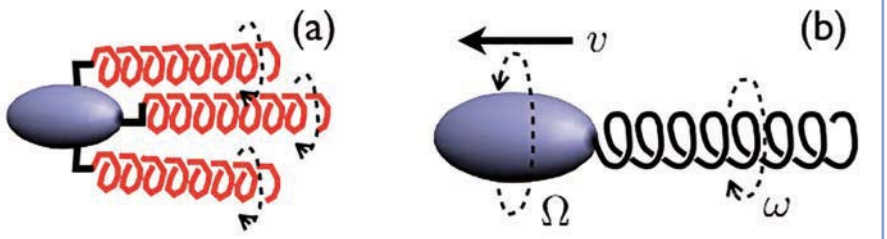
Some bacteria are able to swim, locomotion being another ubiquitous characteristic of living organisms. The biophysics of *E. coli* self propulsion is known in some detail. Each cell expresses 7-10 helical flagella on its surface powered by rotary motors. When these rotate counterclockwise (viewed from behind), they bundle into a single helix and propel according to the laws of 'creeping flow' [4], Fig. 2.

Many aspects of bacterial swimming are attracting current attention. Characterisation is a key issue. Thus, we have adapted a new technique originally demonstrated for sizing passive colloids [6], differential dynamic microscopy, for the high-throughput measurement of the swimming speed distribution of not only bacteria [7], but also of other micro-swimmers such as algae [8]. Using this and a related technique for studying the rotating cell body of swimming *E. coli*, we have shown that the flagella of these bacteria rotate so fast that dissolved high polymers shear thin in their vicinity, giving rise to a non-monotonic dependence of the swimming speed on the polymer concentration [9], Fig. 3.

The basic novelty of active matter collective behaviour is that they violate the Principle of Detailed Balance [10]. The coherently-rotating clusters formed when motile *E. coli* aggregate due to the depletion effect of added non-adsorbing polymers [11] is one manifestation of such violation of detailed balance. The observation of coherent swirls in swimming bacteria confined to cylindrical [12] or spherical [13] emulsion drops is another. In the latter case, we also found that the way swimming *E. coli* lls up a spherical emulsion droplet, Fig. 4, has striking similarities to the behaviour of a raried gas conned to a spherical cavity with adhesive walls. In our case, an 'effective adhesion' is provided by the well-known tendency of swimmers to continue to swim along a surface once they encounter such a surface. Note that such 'wall hugging' trajectories clearly violate detailed balance.

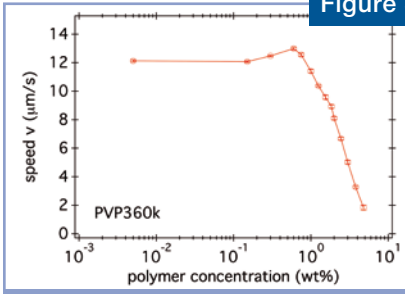
The study of bacteria as active colloids is in its infancy. Much basic science remains to be elucidated, whether it be in the physics of colony growth or in the single-body and collective behaviour of swimming cells. Moreover, possible practical applications have barely been explored. Thus, for example, it is known that self-propelled particles enhance the diusive motility of passive particles – we have recently studied the three-dimensional version of this phenomenon experimentally [14] and theoretically [15]. Thus, swimming bacteria may find use as agents for enhancing mixing on the microscopic level. The above-mentioned coherently rotating clusters could become the rotors in self-assembled micro-motors or pumps. On the other hand, it should be possible to 'tune' the shapes of self-assembled bacterial colonies by manipulating their surface properties, genetically or otherwise, thus offering yet another route to active self assembly on the colloidal scale. The resulting bacterial structures could be turned into traditional colloids for further processing using recently-published protocols [16]. The infant science of bacteria as active colloids therefore offers considerable scientic and technological potential.

Figure 2



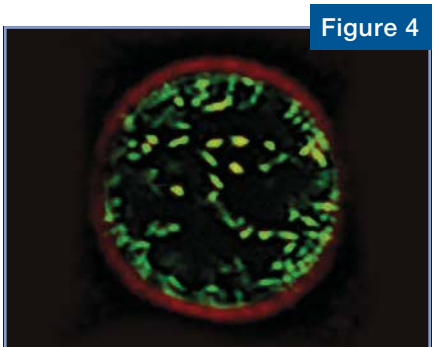
(a) A schematic of an *E. coli* bacterium with multiple flagella rotating counterclockwise. (b) The bundled flagella is often represented as a single 'effective' flagellum. In both: length of cell body ~ 2 μm, flagellum ~ 7 μm.

Figure 3



The average swimming speed of *E. coli* as a function of concentration (in wt.%) of purified 360k molecular weight PVP polymer. Courtesy of Vincent Martinez.

Figure 4



Snapshot of motile *E. coli* bacterium in a 14 μm water droplet in oil at 3.5% volume fraction of cell bodies. Note the higher cell density at the edge. Courtesy of Dana Vladescu.

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Microswimmers in silico

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Life is motion. This is not only true on the macroscopic scale of humans, cars, airplanes, and submarines, but also in the microscopic world of bacteria, sperm, parasites, and algae. Soft Matter research, which so far has mainly focused on suspensions of passive particles, under equilibrium as well as under non-equilibrium conditions, is rapidly expanding into the field of active particles. This is driven by the fact that active particles are entirely different from classical non-equilibrium systems, as they convert thermal or chemical energy into translational or rotational motion internally. In the world of microorganisms, this helps bacteria to find food and to invade host cells, sperm to reach the egg, and algae to move toward the source of light.

Biological microswimmers such as bacteria like Escherichia coli, spermatozoa, and Paramecia are typically a few to several ten micrometers in size and are propelled by flagella or cilia protruding from their bodies. The physics ruling swimming on such length scale is very different from that of the macro-world. Swimming on the micrometer scale is swimming at low Reynolds number, where viscous damping dominates over inertia. In the evolutionary process, microorganisms acquired propulsion strategies, which overcomes and even exploit drag. Hence, hydrodynamic interactions are essential for swimming. This not only applies to propulsion in general, but also to synchronization of flagella and cilia motion during bundle formation in bacteria swimming and formation of metachronal waves on the surface of Paramecia.

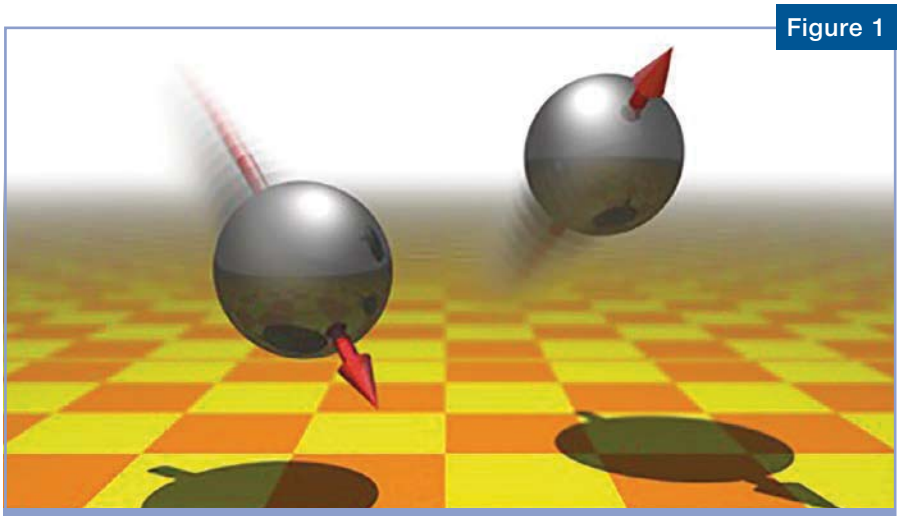
Inspired by traditional Soft Matter activities, various concepts for synthetic microswimmers have been suggested and designed. These range from biomimetic swimmers, which use similar propulsion mechanisms as the microorganisms mentioned above, to completely new designs of artificial microswimmers. In the former case, a nice example is a sperm-like microswimmer, which has been constructed by attaching a red blood cell (as head) to a chain of magnetic colloid particles (as tail), which is then wiggled by an external magnetic field. In the latter case, the prominent example is Janus colloids, which have a catalytic coating on one side to induce a chemical reaction in the solvent (typically hydrogen-peroxide) or are heated on the coated side by a laser beam to induce temperature or concentration gradients in the surrounding fluids.

From the viewpoint of Soft Matter research, interesting problems of such systems to study are: How does a single microswimmer move? What is the behavior in confinement? How do microswimmers interact? What is the role of hydrodynamic interactions? What is the collective behavior of microswimmers? How do microswimmers behave in external fields? All these questions are very similar to questions, which have been addressed for passive Soft Matter for decades. However, because microswimmer suspensions are intrinsically far from equilibrium, the answers often are completely different [Elgeti2014]. We demonstrate this new behavior by a few examples from our own research below.

The broad spectrum of available mesoscale computer simulations, ranging from Brownian dynamics to sophisticated hydrodynamic simulations, combined with analytical approaches, e.g., via the Langevin or Fokker-Planck equations, provide the basis for an in-depth study of active systems. Thereby, the simplest possible model of a microswimmer is an active Brownian sphere (ABP). This model neglects many aspects, like particle elongation, alignment mechanisms, and hydrodynamic interactions, but emphasizes generic aspects – such as the interplay between self-propulsion and volume exclusion, and the emerging collective behavior by many particles.

The presence of surfaces and confinement strongly affects the distribution and dynamics of active particles (see Fig.1). A passive spherical colloid displays neither aggregation nor depletion near walls. However as directed motion is added, particles starts to accumulate at surfaces [Elgeti2013a] (a similar behavior is seen for active rod-like particles [Elgeti2009]). Indeed, as already observed in the 1960s, sperm cells accumulate at the glass cover slip of the observation chamber. At first, this looks counterintuitive, because the localization of a particle next to an interface reduces its entropy. However, the aggregation mechanism can be understood qualitatively as follows: A particle which moves persistently in one direction, will necessarily hit a wall after a while; after this collision, it is on average oriented toward the wall, and it takes a time on the order of the rotational diffusion time until the particle can move away from the wall again.

Figure 1



Schematic representation of active Brownian particles moving near surfaces. The arrow indicates the direction of motion.

Active Brownian particles exhibit a fascinatingly rich collective behavior [Wysocki2014]. At low densities and swimming velocities, the particles show a gas-like behavior comparable to passive particles. However, above a certain Peclet number and density, they phase separate into a dense fluid and a dilute gas phase. Thereby, the local density of the fluid phase =0.62 is considerably higher than the critical density =0.56 for glass formation of passive particles in three-dimensional space. At a given Peclet number, the morphological character of the two-phase region changes with increasing density from a fluid droplet over a bicontinuous structure to a gas-phase droplet imbedded in a fluid phase. In contrast to two-dimensional active systems,

Microswimmers in silico (continued)

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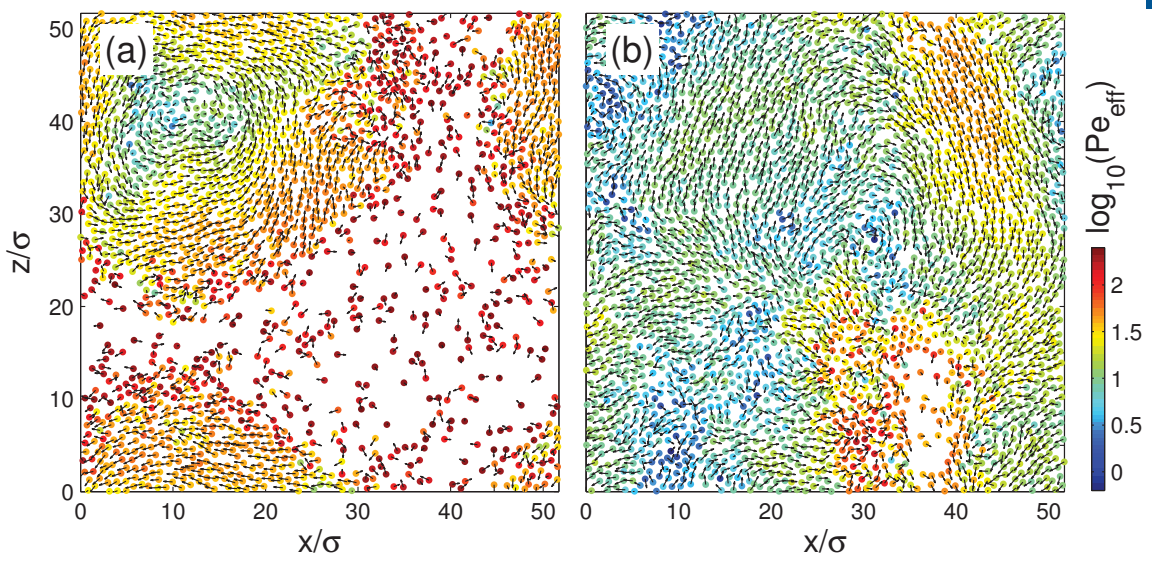
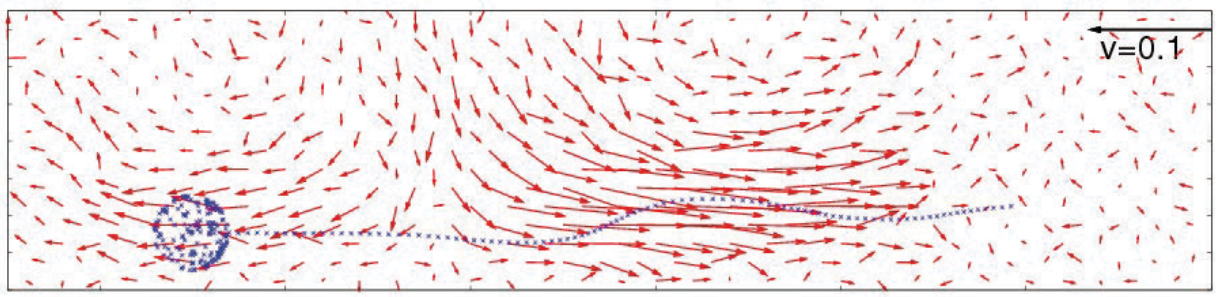
Figure 2



Collective motion in the steady state at high Peclet number Pe. Snapshots (slices of thickness of the hard-sphere diameter) of a system (a) just above the clustering transition (= 0.34) and (b) at a high concentration (= 0.60). The color code shows the magnitude of the local displacements [Wysocki2014].

where crystalline clusters are formed, the dense phase is fluid-like up to rather high densities close to random-closed packing. Here, the glass-transition density shifts to higher average packing fractions. Particularly remarkable is the dynamical behavior of the Brownian particles in the dense phase, where they exhibit jets, swirls, and turbulence, see Fig.2, similar to experimental observations in bacterial colonies. A detailed analysis shows long-range and scale-free dynamical correlations. This is surprising, because there is no alignment mechanism between the moving directions of individual particles. Activity and excluded volume interactions suffice to generate highly complex dynamical patterns. Of course, the investigation of active Brownian particles can only give a glimpse into the enormous richness of behaviors of active systems [Elgeti2014]. As is true for all Soft Matter science, the interesting behavior arises from the competition between the generic and the specific features. For microswimmers, there is a bewildering variety of propulsion mechanisms, from the snaking, rowing, and rotational motion of sperm flagella [Elgeti2010], cilia [Elgeti2013b], and bacterial flagella [Reigh2013], respectively, to the diffusion- and thermophoretic propulsion of Janus colloids. Also, concentration fields and hydrodynamic flow fields can play an essential role in determining the interactions between microswimmers. An example is the adhesion of sperm or bacteria to surfaces, which is enhanced or dominated by hydrodynamic interactions [Elgeti2010], see Fig.3.

Figure 3



Hydrodynamic flow field of a sperm near a wall (bottom). Due to the backward flow generated by the beating flagellum und the forward flow generated by the head, the sidewise inflow induces a effective attraction to the surface [Elgeti2010].

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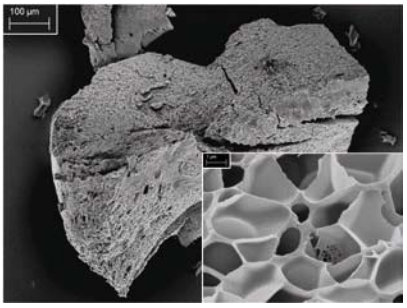
SoftComp Network Research Highlights 2014

Microcellular foams made from gliadin

S. Quester, M. Dahesh, and R. Strey
SoftComp partner: Univ. Cologne, Colloid Polym Sci (2014) 292:2385–2389

In Cologne we have generated closed-cell microcellular foams with thin membranes of only a few nanometers from gliadin, an abundantly available wheat storage protein, provided by Montpellier. A genuine SoftComp collaboration. The extraction procedure of gliadin from wheat gluten, which involves only the natural solvents water and ethanol, respectively, results in a fine dispersion of mostly spherical, submicron gliadin particles assumed to be composed of millions of protein molecules. A dense packing of these particles was hydrated and subjected to an atmosphere of carbon dioxide or nitrogen in a high-pressure cell at 250 bar. Subsequent heating to temperatures close to but still below 100 °C followed by a sudden expansion and simultaneous cooling resulted in closed-cell microcellular foam. The spherical gliadin templates along with the resulting foam have been analyzed by SEM pictures. The size distribution of the primary particles show diameters peaked around 0.5 µm, the final foam cell size peaks around 1.2 µm at a porosity of 80%. These are clearly the smallest foams ever obtained from gliadin. Interestingly, the cell walls of these microcellular foams are remarkably thin with wall thicknesses in the lower nanometer range, thus nourishing the hope to be able to reach gliadin nanofoam. The procedure is simple and low cost, possibly lending itself to a technical realization.

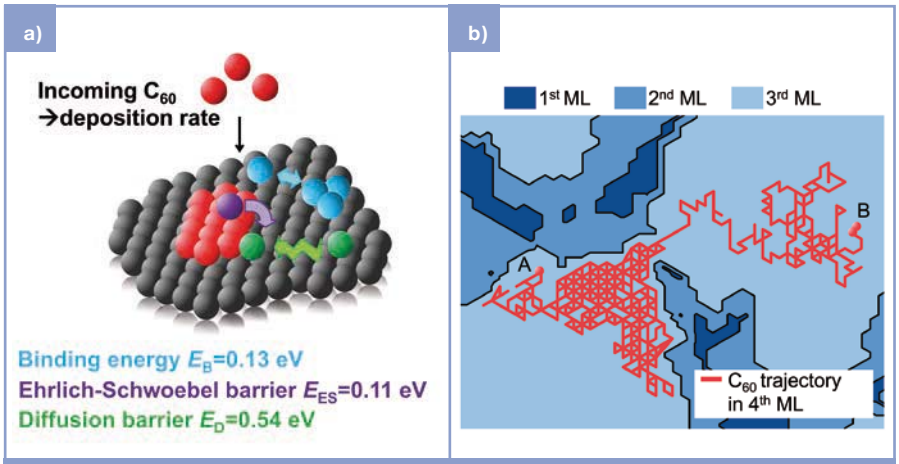


SEM-picture of the fracture face of the foam resulting from foaming procedure of hydrated gliadin (wH2O = 33 wt%) which was soaked with fluid CO2 at room temperature, heated to 95 °C while the pressure was adjusted to 250 bar for 30 minutes followed by a sudden expansion while slowly cooling to 25 °C (scale bar is 100 µm, respectively 1 µm).

Unravelling the multilayer growth of the fullerene C60 in real-time: growth phenomena at the boundary between atomic, molecular and colloidal systems

S. Bommel, N. Kleppmann, C. Weber, H. Spranger, P. Schäfer, J. Novak, S. V. Roth, F. Schreiber, S. H. L. Klapp, S. Kowarik
SoftComp partner: Univ. Tübingen to appear in Nature Communications

Self-assembly of molecular building blocks into functional nanomaterials is increasingly used in devices, but the non-equilibrium processes of molecular film growth on a nanoscopic level are not yet fully understood and hard to predict. In this study real-time x-ray scattering experiments performed at the MiNaXS beamline at PETRA III (DESY) combined with kinetic Monte-Carlo (KMC) simulations shed light on growth phenomena of fullerene C60, that is for a building block size ranging between the atomic scale and colloidal scales. The main result of our study is the quantification of the energy landscape for the basic growth processes of diffusion within a layer, diffusion across a step edge and binding to islands of fullerene C60 (see Figure 1a). This growth study bridges the gap between the growth of small atomic and large colloidal systems, by showing that the molecular step-edge crossing process is similar to atoms, but unlike colloidal growth. In contrast, the lateral surface diffusion lengths and diffusion times of a C60 molecule - see Figure 1b for an exemplary trajectory - resemble colloidal epitaxy. In conclusion, our work enables quantitative predictions of the growth mode and interface morphology of C60 and thereby helps in a systematic understanding of growth of molecular and soft materials.



a) Surface processes during C60 growth and b) simulated C60 trajectory in the 4th monolayer (ML) showing long diffusion times and the effect of the step edge barrier preventing jumps into the lower layer.

Nickel Nanoparticle-Doped Paper as a Bioactive Scaffold for Targeted and Robust Immobilization of Functional Proteins

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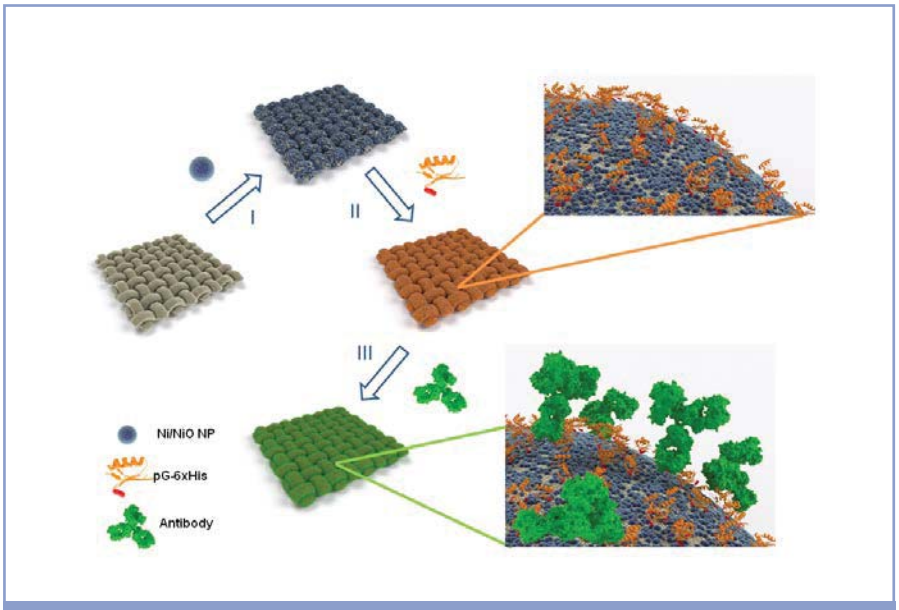
SoftComp partners: CIC BiomaGUNE and Universidade de Vigo

Cellulose-based materials are widely used in analytical chemistry as platforms for chromatographic and immunodiagnostic techniques. Due to its countless advantages (e.g., mechanical properties, three-dimensional structure, large surface to volume area, biocompatibility and biodegradability, and high industrial availability), paper has been rediscovered as a valuable substrate for sensors. Polymeric materials such as cellulosic paper present high protein capture ability, resulting in a large increase of detection signal and improved assay sensitivity. However, cellulose is a rather nonreactive material for direct chemical coupling. Aiming at developing an efficient method for controlled conjugation of cellulose-based materials with proteins, we devised and fabricated a hybrid scaffold based on the adsorption and in situ self-assembly of surface-oxidized Ni nanoparticles on filter paper, which serve as "docking sites" for the selective immobilization of proteins containing polyhistidine tags (His-tag). We demonstrate that the interaction between the nickel substrate and the His-tagged protein G is remarkably resilient toward chemicals at concentrations that quickly disrupt standard Ni-NTA and Ni-IDA complexes, so that this system can be used for applications in which a robust attachment is desired. The bioconjugation with His-tagged protein G allowed the binding of anti-Salmonella antibodies that mediated the immuno-capture of live and motile Salmonella bacteria. The versatility and biocompatibility of the nickel substrate were further demonstrated by enzymatic reactions.



Schematic representation of the preparation of a bioactive scaffold, comprising (I) nickel NPs on filter paper, (II) targeted immobilization of the polyhistidine-tagged protein G (pG-6xHis), and (III) protein G-mediated capture of antibodies. Protein G is represented by the protein G B1 domain (PDB: 1GB1, orange) bearing a 6xHis at its C-terminus (red). The antibody is an IgG2a immunoglobulin (PDB: 1IGT, green).

About SoftComp

SoftComp is a Network of Excellence – a tool developed under the 6th Framework Programme of the European Commission dealing with the integration of European research, with the intention of strengthening scientific and technological excellence. In particular, SoftComp aims to establish a knowledge base for an intelligent design of functional and nanoscale soft matter composites. It will do so by overcoming the present fragmentation of this important field for the development of new materials at the interface of non-living and living matter, where the delicate principles of self-assembly in polymeric, surfactant and colloidal matter prevail. This Network of Excellence has created an integrated team that is able to activate the European potential in soft matter composite materials and thus disseminate excellence through extensive training and knowledge transfer schemes. Since December 2009, when EU funding came to an end, Softcomp has been a self-supporting consortium consisting of 40 research groups belonging to 36 different institutions.

- **SoftComp partner details**
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- **Registration**
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SoftComp Network Activity Highlights 2014

New SoftComp Partners

Soft Matter @ETH Zürich

Prof. Jan Vermant

The Department of Materials of the ETH Zürich joined SoftComp in 2014. The main point of contact is the laboratory of Soft Materials, which started august 1st and is headed by Prof. Jan Vermant. Research activities focus on soft matter composites, and the rheology of bulk materials and interfaces is a key point. There is a broad range of soft matter activities in the department, for example in the group of Prof. Lucio Isa (interfaces), Prof. Dieter Schlüter (polymer chemistry and Prof. Andre Studart (complex materials), prof. Markus Niederberger (multifunctional materials).

Soft Matter @IMMM Le Mans

Prof. Taco Nicolai

The Institute of Molecules and Materials of Le Mans (IMMM) in France unites chemists and physicists with the objective to produce and investigate different types of materials. In important activity within the institute is synthesis of functional polymers and investigation of the properties of soft materials and interfaces formed by these polymers. Another area of research relevant to the SoftComp community is materials (emulsions, complex liquids, gels) from biomacromolecules for application in the areas of food and medicine. IMMM has joined SoftComp in 2014 and is actually headed by Jean Marc Greneche.

Soft Matter @DICMaPI Napoli

Prof. N. Grizzuti

The group of Soft Matter in Napoli, at DICMaPI, Unina deals with various subjects with an approach that is experimentalist, simulative and theoretical. The experimental group focuses on polymer melts, surfactants, suspensions of spheres, liquid crystals, polymer blends and emulsions, biological fluids etc, mainly through rheology and microscopy. The experimental approach is strengthen by a group of theoreticians which is able to develop constitutive equations for the flow behaviour of macromolecular fluids and a simulation group, capable to model and numerically simulate soft matter problems.

SoftComp Topical Workshops Reporting 2014

Proteins @ nanoparticles @ membranes

The SoftComp Topical Workshop "Proteins @ Nanoparticles @ Membranes" (www.fz-juelich.de/ics/pam-softcomp) brought together researchers interested in nanoparticles, proteins, lipid membranes, and surfactants. New scientific results were presented in 38 talks and on 39 posters in sessions on nanoparticle-membrane interaction, viruses, adhesion, pathogen interactions, complex membranes and the cytoskeleton, membrane-protein interactions, interactions on the molecular scale, parasites, particle-wrapping calculations, nanoparticle uptake by cells, and experimental model membranes. The diverse mixture of scientists, from established researchers to PhD students, lead to stimulating discussions and a productive exchange of knowledge and ideas.
The workshop took place on October 19-22 at Forschungszentrum Jülich. Jointly organised by Thorsten Auth, Patricia Bassereau, and Gerhard Gompper, it has attracted 93 participants from physics, chemistry, and biology, among them 25 colleagues from SoftComp. An afternoon session with introductory courses before the start of the workshop has been attended by about 40 students. Participants originated from 20 countries: Germany, France, United Kingdom, Switzerland, Sweden, The Netherlands, Belgium, India, United Arab Emirates, Spain, Denmark, Finland, Hungary, Ireland, Israel, Iran, South Korea, Slovenia, Singapore, and South Africa.

Fracture of Soft Materials: from soft solids to complex fluids

(http://soft-fracture.eu/) was held from 15 to 18 October 2014 in the scenic fishing Harbour of Palavas-les-Flots on the French Mediterranean coast near Montpellier. Organized by C. Ligoure, T.Baumberger, J. van der Gucht and J. Sprakel , the workshop was a bet which brought together people from a variety of backgrounds (soft matter physics , fracture mechanics, rheology, material science) to explore new frontiers in the fracture behaviour of soft materials,and to stimulate the coming-of-age of this growing field. 54 participants from nine different countries including three non European ones (Japan, USA and Israel) took part in this workshop. The scientific program was consisting of nine sessions: (1) crack propagation, (2) brittle to ductile transition , (3) tough gels, (4) instabilties in yield stress fluids, (5) kinetics of fracture, (6) cuttering, fingering, drilling, (7) interfacial fracture, (8) fracture of elastomers , (9) adhesion and peeling. Each session consisted of 2 to 4 talks given by 23 invited speakers and the organizers. Additionally, two soundbites sessions provided the opportunity for 13 young researchers (PhD students and postdocs) to present their works. Beside SoftComp, the workshop was also supported by the Labex NUMEV, the University of Wageningen and the Laboratoire Charles Coulomb.

SoftComp Annual Meeting 2014

The SoftComp Annual meeting 2014 took place at the Knossos Beach Hotel, Heraklion, Greece, from 26th to 29th May 2014. Due to the strong collaboration between the two projects, following the positive experience of the last years, the SoftComp Annual meeting 2014 was held in conjunction to the European Soft Matter Infrastructure (ESMI) one. Thanks also to nice location, the SoftComp Annual Meeting 2014 was a great success with the largest number of participant ever: 177 persons attended the event, among which, 2 invited speakers and 12 ESMI users. The SoftComp participants represented 35 out of the 39 SoftComp groups, showing that SoftComp is a lively community. The distribution of the SoftComp participants is shown in the figure below.

Topical Workshop:
Dense Suspension Flow

Understanding the flow of suspensions of solid particles at high volume fractions is an imperative in industrial applications across diverse sectors. It is also a fascinating problem that has captured academic attention for some time. Recent progress from experiments, theory and simulations suggest that a grand synthesis may be within reach. This focussed workshop aims to bring together some of the principal participants from a range of disciplines and perspectives to review recent progress and discuss ways forward. The format of the meeting includes significant discussion time of the individual presentations throughout, and for gathering the threads and synthesising our ideas together at the end. In view of the practical relevance, there will be speakers from industry giving their perspective, and other industrial participants are encouraged.

Organizers: Wilson Poon, Mike Cates, Dimitris Vlassopoulos
Date: June 1-3, 2015
Location: Edinburgh, Scotland, UK

Topical Workshop:
Ring Polymers: advances and perspectives

Understanding the properties of ring polymers is one of the outstanding challenges in polymer science, in particular in relation to the physics of entanglements. However this fascinating field has implications also in biologically relevant problems. For example, mitochondiral and plasmic DNA are cyclic and often has knotted structure. Ring polymers are ideal models for fundamental bio-physics problems as well. Chromosomes often exhibiy conformation resembling that of non-concatenated rings. Although the cyclic structure of DNA was reported in the early 60s and synthetic ring polymers were synthesized in the 80s, the filed advanced only recently with a synergy of state-of-the-art synthesis, characterization with interaction chromatography, critical fractionation, physical experiment, modeling and simulations. In this workshop, leading researchers in these different areas will meet to discuss the emerging trends and explore new frontiers.

Organizers: Dimitris Vlassopoulos, Dieter Richter, Michael Rubinstein
Date: July 13-15, 2015
Location: Aldemar Mare Thalasso Resort, Crete, Greece
Registration & information:
http://www.aldemar-resorts.gr/EN/Thalasso%20resorts/Royal%20Mare/

Coming Up ...

Soft Matter related international conferences / courses / workshops / schools ...

NB. : As of 1. April 2015 you will find at the new SoftComp Microsite periodically updated and more detailed meeting information.

www.eu-softcomp.net/news/newsletter-microsite

23 February - 6 March 2015
46th IFF Spring School 2015 Functional Soft Matter Course
Jülich, Germany
Registration & Info: *www.iff-springschool.de*

14 - 17 April 2015
AERC 2015 NANTES
at Nantes event centre, La Cité
The European Society of Rheology
www.rheology-esr.net

18 - 22 May 2015
6th LABORATORY COURSE ON DIELECTRIC SPECTROSCOPY
The laboratory course is a joint ESMI / SOFTCOMP initiative
San Sebastián, Spain
http://www.sc.ehu.es/sqwpolim/PSMG/BDSLC/
Prof. Angel Alegria, *angel.alegria@eho.es*

27 May - 3 June 2016
13th European Summer School on 'Scattering Methods Applied to Soft Condensed Matter'
At the vacation centre »Les Bruyères«, in Bombannes, France · Dr. Peter Lindner

1 - 3 June 2015
SoftCompTopical Workshop:
Dense Suspension Flow
Organizers: Wilson Poon, Mike Cates, Dimitris Vlassopoulos
Location: Edinburgh, Scotland, UK

9 - 11 June 2015
SoftComp Annual Meeting 2015
Ancona, Italy
Dr. Flavio Carsughi

14 - 20 June 2015
AMPERE NMR SCHOOL 2015
ZAKOPANE, Poland · S.Jurga
www.10times.com/ampere-nmr-school

22 - 24 June 2015
SoftComp International Workshop on 'Structure and Dynamics of Polymer Nanocomposites'
This two-and-a-half-day international workshop, taking place in Montpellier, will bring together around 50 scientists from academia and industry. It will focus on polymer nanocomposites, from synthesis to physical characterization, modelling and applications, with a mixture of top-level invited speakers and contributed talks. You can submit your abstracts by email to: *anne-caroline.genix@univ-montp2.fr* or *julian.oberdisse@univ-montp2.fr* anytime before the end of March 2015. Further information will be available soon at *www.coulomb.univ-montp2.fr/*
Montpellier, France

5 - 10 July 2015
EUROMAR 2015
Prague Congress Centre,
Prague, Czech Republic
www.euromar2015.org

13 - 15 July 2015
SoftCompTopical Workshop:
Ring Polymers: advances an perspectives
Organizers: Dimitris Vlassopoulos, Dieter Richter, Michael Rubinstein
Location: Aldemar Mare Thalasso Resort, Crete, Greece
Registration & information:
http://www.aldemar-resorts.gr/EN/Thalasso%20resorts/Royal%20Mare/

6 - 11 September 2015
ECIS Conference
Conference of the European Colloid and Interface Society
Bordeaux, France.
http://www.ecis2015.org/

7 - 11 September 2015, Jülich
14 - 18 September 2015, Garching
JCNS Laboratory Course 2015
Jülich & Garching, Germany
R. Zorn · *reiner.zorn@gmail.com*

12 - 16 September 2016
International Soft Matter Conference 'ISMC 2016'
Grenoble, France
First announcement with flyers and posterswill be distributed in this summer this year.

10 - 13 November 2015
Jülich Soft Matter Days 2015
Seminaris Hotel,
Alexander-von-Humboldt-Str. 20,
53604 Bad Honnef, Germany
Information: *www.seminaris.de/badhonnef*
J. Dhont, D. Richter, G. Gompper
http//www.fz-juelich.de/ics/jsmdays/

For more frequently updated information, please see also the SoftComp web pages ...
Vacancies: ***www.eu-softcomp.net/news/jobs*** · SoftComp News: ***www.eu-softcomp.net/news/***
SoftComp Events: ***www.eu-softcomp.net/news/cal*** · SoftComp Newsletter-Microsite: ***www.eu-softcomp.net/news/newsletter-microsite***

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