SoftComp
SOFT MATTER COMPOSITES
Network of Excellence
www.eu-softcomp.net

newsletter
No. 4 · July 2007

Editorial

When you read this issue of the newsletter, SoftComp will have entered its fourth year as a Network of Excellence delivering the most encouraging results.
First of all, SoftComp's scientific achievements were graded highly in international reviews. Furthermore, a Research Road Map has been firmly embedded, defining the medium-/long-term research prospects for the SoftComp NoE during the next 10 years.
But probably the most welcome news regards the aspect of the extension of SoftComp as an NoE. The majority of the present SoftComp partners have signed a letter of intent, based on a consortium agreement worked out jointly, to continue with SoftComp as an NoE and to finance the network after the termination of EU support.
This is the good news for a bright future for SoftComp which compensates for the hard work by all participants and the "occasional" burden of administration.
You will find more information on the Research Road Map inside the newsletter (page 7).
Hugo Bohn & Dieter Richter

Latest News

Majority of SoftComp partners in favour of continuing with SoftComp after termination of EU support.

Two new partners to join the SoftComp Network of Excellence (for details see page 8)**.**

In This Issue

Soft Matter for Understanding Intracellular Trafficking

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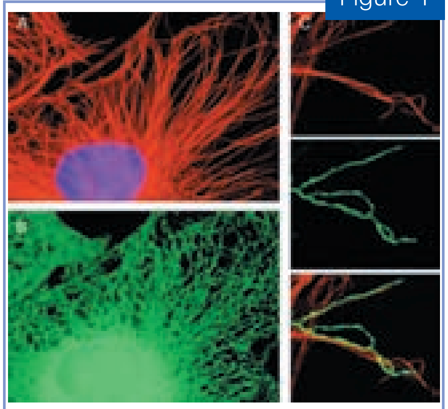
Introduction

Eukaryotic cells (i.e. from animals, plants, fungi) contain many different intracellular compartments (organelles), all surrounded by lipid membranes. Cells are also delimited by the plasma membrane. The organelles are very dynamic and undergo a constant exchange of proteins and lipids with the plasma membrane and other intracellular compartments. This traffic is used by cells to internalize substances provided by the outside, communicating with other cells, or delivering lipids or proteins after synthesis to another organelle to be further transformed or to express their function. The intracellular traffic must be precisely targeted and cannot be achieved by simple molecular Brownian diffusion. In general, the transport between organelles requires the formation of transport intermediates, carrying specific cargos and lipids. For many years, it was believed that transport intermediates were essentially small spherical vesicles with a typical diameter of 100 nm, transported by molecular motors along cellular rails, very rigid protein polymers called microtubules.

However, in the last 10 years it has been observed – in particular by B. Goud at the Curie Institute [1] – that transport was achieved in some cases by long thin tubular membrane structures as well (Figure 1). Although it was established that the formation of these membrane tubes also implied molecular motors and microtubules, the detailed mechanisms for tube formation and growth were not known. This is where biophysicists using concepts and tools coming initially from soft matter physics contribute significant input to this problem. Indeed, it was necessary to combine the physics of membrane tubes with the complexity of the physics of molecular motors to provide a complete and rich model for the formation of tubular transport intermediates.

Figure 1



Membrane tubes in the endoplasmic reticulum (ER) of a cell using immunofluorescence microscopy:
A: Microtubules (red) and nucleus (blue). **B:** ER membrane (green).
C: Enlargement of A and B.
Membrane tubes grow along microtubules.

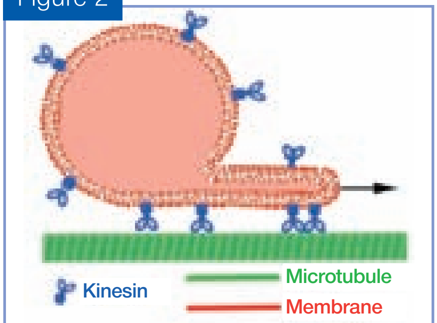
Taken from Viki Allan's website: www.ls.manchester.ac.uk/research/themes/organellefunction/proteintransport

Soft Matter for Understanding Intracellular Trafficking (continued)

Membrane Nanotubes Formed by the Collective Action of Molecular Motors

In order to understand the formation of these tubes *in vivo*, an efficient strategy is to prepare and study a minimal biomimetic system *in vitro* containing the relevant components (Figure 2): molecular motors (kinesins) are bound

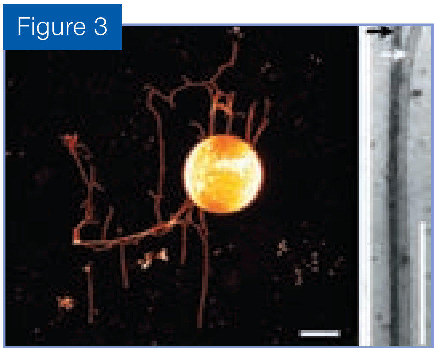
Figure 2



Biomimetic system: Kinesins are bound to a giant vesicle and in contact with a microtubule immobilized on a glass substrate. In the presence of ATP, they move, pull on the membrane and form a tube.

to a giant vesicle (GUV), when they are in contact with microtubules they move along these rails and being attached to the membrane exert a force on it, deform it, thus leading to tube formation then mimicking the tubular structures in cells [2, 3]. The tubes grow with a velocity ranging from 0.1 to 0.5 µm/s, also similar to observations in cells. They can extend over tens of micrometres and form tube networks (Figure 3-left); their diameter is typically between 30 and 100 nanometres (Figure 3-right). For this reason, we call them *fluid nanotubes*. The physics of membrane tubes has also been developing in recent years, both theoretically [4, 5] and experimentally [6]. It has been shown that to pull a tube from a membrane, a local force must be exerted which depends only on membrane mechanical parameters,

Figure 3



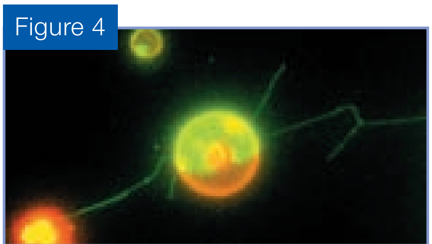
Left: Membrane tube network grown from a GUV (confocal microscopy), bar: 10 nm.
Right: Electron microscopy image of a membrane tube (white arrow) along a microtubule (black arrow), bar: 500 nm (from [3])

the vesicle tension and the bending modulus. Under typical experimental conditions, this force is of the order of 20-30 piconewtons. As the maximal force exerted by a single kinesin is 6pN, a collective action of the motors is required to pull these tubes. How is this possible? A model was developed at the Curie Institute describing this tube formation without any adjustable parameters, and using current knowledge about kinesin dynamical properties. This model proposes that the working motors are at the front edge of the tube and concentrate, as they are slower than the motors, at the rear; this creates a cluster of motors which collectively can exert the necessary force. In parallel, experiments at the same laboratory have confirmed the presence of motor clusters at the tip of the tubes. Between 20 and 30 motors cooperate in pulling the tube. Different predictions made by the model have been directly confirmed, for instance the exponential decay of the motor concentration at the tip of the tube. Moreover, theory and experiments together showed the existence of thresholds for membrane tension and motor concentration. These findings have important consequences for cellular transport regulation, as these thresholds can function as on/off switches [7].

Multi-component Membrane: Sorting and Fission

One of the roles of transport intermediates is the sorting of cell components to be delivered to another organelles. Cell membranes are composed of a rich and complex mixture of lipids and many different proteins. Understanding sorting processes is one of the current hot questions in cell biology. Using the same minimal system with a mixture of lipids, it was possible to show that the high curvature of the tubes (i.e. their small diameter) highly favours some lipids in the tube and that their concentration in the tube is greatly amplified compared to the vesicle [8] (Figure 4).

Figure 4



Membrane tubes grown from a two-phase GUV (confocal microscopy). Tubes contain only the green phase, with the lowest bending modulus (from [8]).

In cells membrane tubes (eventually) detach from the donor organelle. Interestingly, a spontaneous fission is never observed in the biomimetic system with vesicles containing one type of lipid. However, if the vesicle contains a lipid mixture, spontaneous fission can occur upon phase separation in the tube. Theory and experiments show that this is due to the line tension between lipid domains, which tends to pinch the tube and destabilize it [8, 9]. In cells, different proteins are also involved in tube fission, notably dynamin. This protein is able to self-assemble and form a helical structure wrapping around membranes; it has been shown that this is a new type of molecular motor whose twisting action induces membrane constriction [10]. This protein is also involved in the detachment from transport vesicles of the plasma membrane. One of the natural challenges is now to precisely understand the fission mechanism of this type of protein.

Conclusion

We have given here an example of a very fruitful collaboration between experimentalists and theoreticians from soft matter physics addressing a very relevant question for cell biology.

A close collaboration with cell biologists is absolutely necessary. It is now possible to understand how the tubular transport intermediates form and how the collective action of molecular motors can take place.

A fully quantitative description is thus possible, which is rarely the case in cell biology. Many interesting physics questions emerged after this work, related to the physics of traffic jams or to the collective effects of molecular motors showing that if physicists can significantly contribute to cell biology, conversely biological problems also open up many interesting issues for physics.

References

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Simulations of the Flow of Polymer Melts and Solutions

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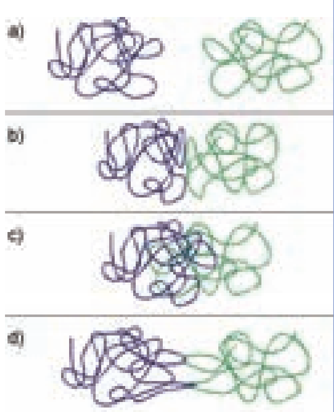
Huge amounts of polymers are processed industrially every year. Understanding the flow behaviour of polymer melts and solutions is therefore of tremendous importance. A lot of money can be saved by designing polymers, with suitable properties at appropriate length and time scales. Computer simulations of polymers are severely limited by the fact that many particles are needed to faithfully represent the topology of a long chain.

Since, moreover, the chain as a whole moves much more slowly than the particles of which it is constructed, it is virtually impossible to simulate polymers with complicated flow profiles in confined geometries.

Therefore, the construction and use of coarse-grained models is essential. In an attempt to make some progress, we have developed a very coarse model, in which each polymer chain is represented as a single particle. Without further decoration, of course, such a model will not be able to reproduce the rather special flow properties of entangled polymers. Therefore, with each pair of particles within a predescribed distance from each other we associate a number n_{ij}, which measures the degree of entanglement of the two particles. Each of these entanglement numbers strives towards an equilibrium value $n_0(r_{ij})$ depending on the distance between the associated pair of particles. The introduction of entanglement numbers has important consequences for the forces acting between two particles, schematically depicted in Fig. 1.

Figure 1



a) Two polymers, in a sea of similar polymers, at a distance larger than twice their radius of gyration. No entanglements are formed between these particles; both n_{ij} and $n_0(r_{ij})$are equal to zero.

b) The particles are now at a shorter distance where the equilibrium number of entanglements $n_0(r_{ij})$ is non-zero. Since n_{ij} is still equal to zero strong repulsive forces are active between the particles, while at the same time n_{ij} starts to grow towards $n_0(r_{ij})$.

c) Here n_{ij} has reached the value $n_0(r_{ij})$ and only a weak repulsion is felt by the particles.

d) We quickly brought the particles to their original distance. The number of entanglements n_{ij} is now larger than its equilibrium value at this distance, which is zero. This leads to strong attractive forces, which steadily diminish until n_{ij} becomes equal to $n_0(r_{ij})$.

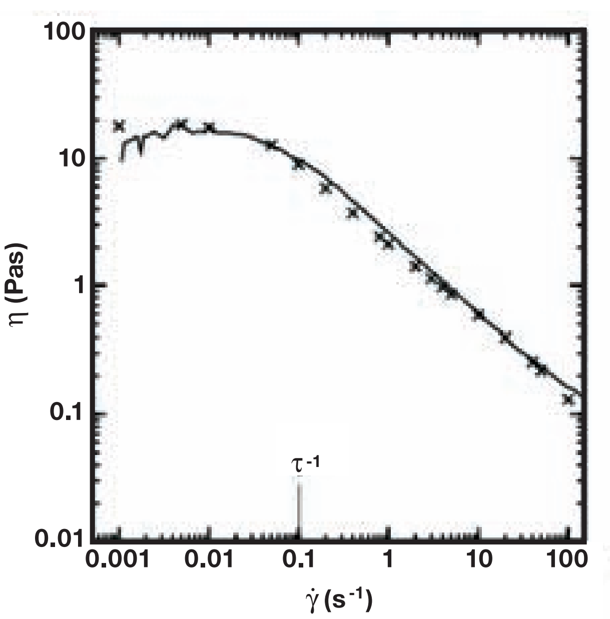
Simulations of the Flow of Polymer Melts and Solutions (continued)

With this model we are able to reproduce qualitatively, and to a large extent even quantitatively, all the structural and dynamic properties of polyethylene melts with $C_{800}H_{1602}$ chains. The same model can be used to simulate the rheological properties of synthetic resins, of which an example is given in Fig. 2. Other applications of the model include the description of lamellar reorientations in block copolymers and the phase separation of dynamically inhomogeneous systems.

Fig. 3 shows the reorientation of the perpendicular state to the parallel state occurring at large shear rates in dynamically asymmetric diblock copolymers, i.e. diblock copolymers in which only A-blocks entangle among each other while B-blocks do not entangle with other B-blocks, nor with A-blocks. In dynamically symmetric systems the perpendicular state is most stable.

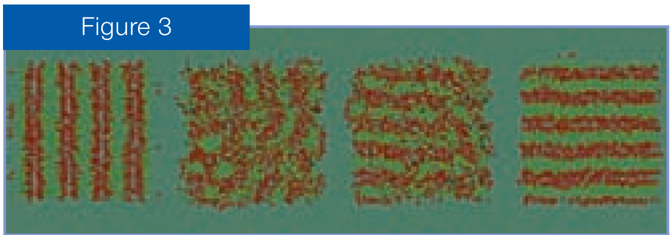
An important aspect of our new model is that boxes with several thousands of polymers can be easily simulated. This opens the way to studying complex flows in confined geometries and near free surfaces. Examples of interest are the study of inkjet printing or even the formation of sharkskin on extrusion of polymer melts (Fig. 4).

Figure 2



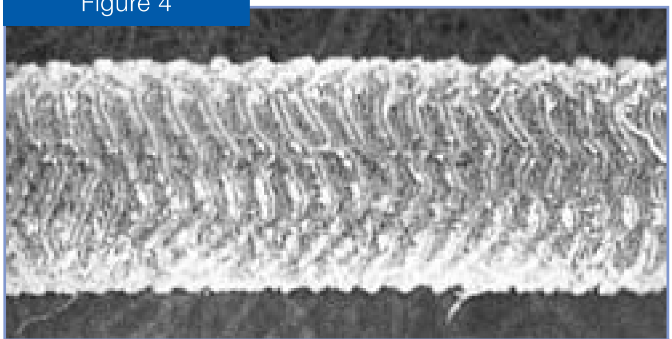
Viscosity versus shear rate for a synthetic resin.
The line drawn is from experiments performed at Akzo-Nobel, Arnhem. Symbols are from simulations.

Figure 3



Reorientation of the perpendicular state to the parallel state in a dynamically asymmetric system. The horizontal axis is the vorticity direction, the vertical axis the gradient direction. The flow is perpendicular to the paper.

Figure 4



Micrograph of the sharkskin effect on an extruded polymer.
From: J. Rheol. 45, 565 (2001)

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-organization in polymeric, surfactant and colloidal matter are ubiquitous.

This Network of Excellence will create 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.

SoftComp partners: www.eu-softcomp.net/about/part

SoftComp funding programme: During the past 8 months more then 100 applications for grants have been submitted.

Registration: 300 participants have already registered. If you want to register contact: f.h.bohn@fz-juelich.de

The Human Element in Soft Matter Composites

Jaap den Doelder *· Dow Benelux B.V. · Performance Plastics and Chemicals R&D · Materials Science and Modeling*
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Partnership and Commitment

SoftComp is a beautiful example of people bonding – people with different backgrounds, different personalities, different interests, but also with a lot in common. There are various opportunities to find common ground for interaction – working together. Catalysed by the support from the European Commission, people from academia and industry cooperate in science and technology, thus contributing to improving what is essential to human progress.
The Human Element campaign emphasizes Dow's focus on attaining this goal. Dow seeks to strategically combine money-making business efforts with responsible care for the world it is part of. Being both profitable and respected is a vision that can only be achieved through partnership and commitment. The campaign pinpoints Dow's collaboration with communities, product responsibility, and energy and climate-change-related challenges. Bonding with humanity will enable us to tackle some of the fundamental issues of the world today: availability of clean drinking water, adequate food supplies, decent housing, and personal health and safety. This article highlights some of the present R&D activities related to this strategy and to soft matter.

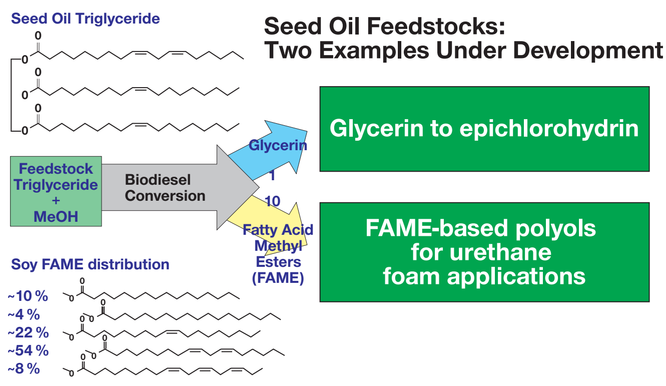
About Dow

The products of The Dow Chemical Company find their way into a large variety of markets and application areas: from food, construction, transportation, paper and publishing via home care, sports, and electronics to personal and household care, health and medicine, and water purification. All these products are designed in the tradition of R&D-based innovation and growth. About 1200 R&D employees are based in Europe. This presence in Europe enables us to establish close collaboration with many external partners.
Dow's portfolio is built upon basic plastics and chemicals, performance plastics and chemicals, agricultural products, and hydrocarbons and energy. The performance products division consists of various businesses. Some are product-based (e.g. epoxy, latex, polyurethane). Others are market-facing (e.g. Dow Automotive, Dow Water Solutions). The basic plastics segments are built upon the important businesses of polyethylene, polypropylene, and polystyrene.

Energy and Alternative Feedstock

Economic and environmental (the Human Element) drivers are working hand-in-hand to trigger exploration of alternative and renewable energy and feedstock sources. Oil and gas prices have increased a lot in recent years. All of us who drive cars know this. For companies such as Dow, who not only obtain energy from these sources, but also use them as feedstock for products, the rise in cost is a very serious issue: four billion dollars extra for Dow in 2005 compared to 2004.
Seed oils are an attractive alternative to petrochemical feedstocks. They offer geographic flexibility and lower cost for selected products. They have no back-integration to chlorine, have a reduced CO_2 burden and are renewable. An example is trygliceride from seed oils. Using this material for biodiesel conversion gives two side products that can be used as base ingredients for two of Dow's businesses (Figure 1).
The first is glycerin. This can be converted to epichlorohydrin, which is used to make epoxy resins. The second is fatty acid methyl ester, which can be converted to polyols that are used in polyurethane foam applications. Flexible foams, such as composite soft matter systems from soy-based polyol, are applied in bedding, furniture, car seats, and carpets. Their performance is comparable to classical petrochemistry-based foams.

Figure 1



Examples of alternative feedstocks

The Human Element in Soft Matter Composites (continued)

Building Solutions

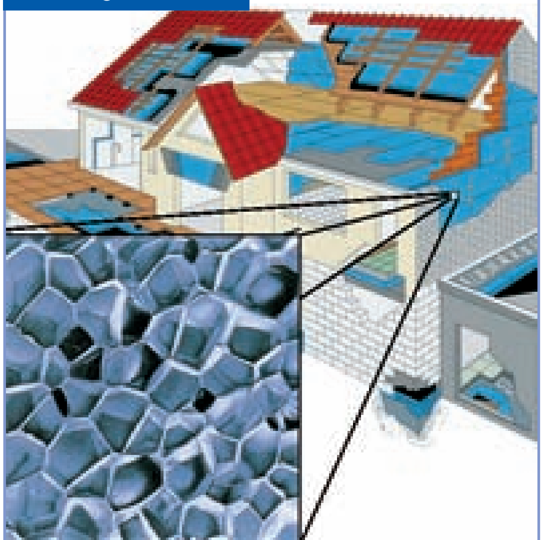
The Human Element requires strong relations between the customer and market-facing units of Dow. As an example, Dow Building Solutions deals with many aspects of construction and home improvement – decent housing. One exciting new development is the solar initiative, a major effort to create economic and affordable solar power systems for the masses. Another example is the well-established set of insulation materials (Figure 2). Dow Styrofoam™ is a polystyrene-based foam for insulating large areas. Great Stuff™ is a polyurethane-based foam sealant that fills gaps by expanding insitu after injection. These solutions help reduce energy use for home-owners by 20-30%. Research in the building solutions area benefits greatly from partnership with external partners. Many products in this field can again be classified as soft matter composites.

Olefin Block Copolymers

The examples in the previous two sections are clearly related to the Human Element philosophy. There are also many developments that may at first sight not seem as significant, but do improve the general quality of life. Examples can be found in the area of optimized properties of products made from polymeric ingredients. Just think of the barrier properties of packaging films to keep your food fresh or the light fibres making up attractive textile fabrics.
A new key development in this field is in the area of olefin block copolymers. To set the stage, let us consider the challenge of creating a product with improved material properties. In designing it, we look for appropriate variables related to the desired properties, and explore them. For a homopolymer, an obvious variable is the molar mass. Put simply, high molar mass gives good mechanical properties, but at the cost of difficult processing. A second area of variation is polydispersity. Within a given class of polymers with limited variability, a single variable is often sufficient to characterize the spread in masses around the average. Broad polydispersity typically improves processing at high rates, and together with average mass it offers more or less independent control of viscosity and, for example stiffness.

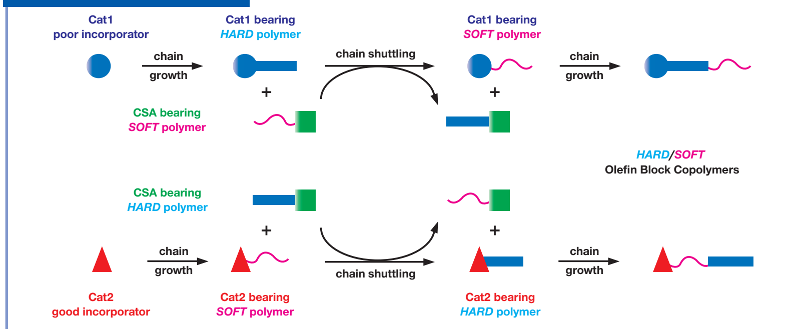
If we want to have even more design options, copolymers made of two chemically different monomer types are a natural choice. Copolymers provide a handle on structure development during crystallization via density control. Generally, such copolymers are random. However, if monomer incorporation can be controlled to a greater extent, it is possible to create designed microstructures beyond density, with selectively enhanced property balances. Specific examples of this are the block copolymers.
Olefin block copolymers are approached from a new angle at Dow via so-called chain shuttling polymerization. The system uses a shuttling agent to transfer growing chains between two distinct catalysts with different monomer selectivity in a single reactor. Figure 3 depicts the chain shuttling mechanism. The copolymers have alternating semi-crystalline and amorphous segments, achieved by varying the ratio of olefin to ethylene in the blocks. The block copolymers have low glass transition temperatures and high melting temperatures, which gives them excellent elastomeric properties at high temperatures. Especially the understanding of

Figure 2



Foam insulation from cellar to roof

Figure 3



Chain-shuttling mechanism
Depiction of the chain shuttling mechanism in a single reactor, dual-catalyst approach. Cat1 (solid circles) and Cat2 (solid triangles) represent catalysts with high and low monomer selectivity, respectively, whereas the CSA (solid squares) facilitates the chain shuttling reaction. Cat1 produces a segment of hard polymer with low comonomer content. Shuttling occurs when this segment is the CSA bearing a soft copolymer of higher comonomer content. Further chain growth at Cat1 then extends the soft copolymer chain by a hard segment, thus yielding a block copolymer.

rheological properties of polymeric systems with different degrees of freedom has increased from interaction within SoftComp.

The Game

Understanding the connection between reactor conditions via molecular structure, rheology, processing, and morphology development to end-use performance properties and back is vital for speed-based new product development. The section on block copolymers illustrates how increasing the number of degrees of freedom increases the design options.

In general, such increased complexity requires more and more fundamental understanding of structure-property relations to find local and global optima. Hybrid fundamental and empirical (data-driven) modeling has become a key discipline in this field. The field is so important that people have conceived various names to describe it. Some call it *the chain of knowledge*. Others, coming more from the modelling side, call it *the game*.

Network Area 4 of SoftComp is for Dow a centre court where the game is being played. Fundamental theories and models enabling the prediction of rheology and processing from molecular topologies are being developed by key academic groups in this field. Model samples of well-controlled architecture are being synthesized and characterized in a wide variety of experimental test conditions by various other groups. The data are used to challenge and improve the models. The application perspective is provided by the industrial partners on the court, who use the predictive models to design complex polymer materials.

Conclusion

This philosophy is exciting. It embodies the values of working together – the Human Element. The Network of Excellence format is proving to be a good stimulus for collaboration. However, nobody said it would be easy: on top of the scientific challenges there are the organizational issues related to the diverse backgrounds and scorecards of the players involved. Particularly for industry, involvement in pre-competitive research is always under pressure. It is therefore ever more important to show clearly how the pre-competitive *academic* nature of the collaboration relates to tangible objectives for society where the industrial partners involved should act as the *profitable and respected* bridge. Balance of technology-push and market-pull is essential. Let us therefore conclude by asking all partners, academic and industrial, to make this mind-set an integrated part of their daily work practice.

The SoftComp Research Road Map

Novel and fascinating research areas are emerging at the interface between physics, chemistry and biology. SoftComp research investigates the properties of macromolecules, colloids and surfactants in solution and in the bulk, their interactions and aggregation, and their cooperative behaviour on nano-to-micrometre length scales. The goal of the SoftComp partners is to establish a quantitative and theoretical understanding of the complex structures and mechanisms governing soft matter composites and related biological systems. The SoftComp research themes are highly complex and require great instrumental efforts and close cooperation between different academic disciplines and between theoreticians and experimentalists.

The medium- to-long-term prospects for SoftComp research are discussed in detail in the Research Road Map, an Annex to the new Consortium Agreement.

Three main research directions are identified there:

1. Molecular engineering and flow rheology

In the quest to optimize and control materials formulations and/or processing, viscoelasticity and flow-induced structure appear to be of foremost importance. This research direction attempts to elucidate the microscopic origin of the rheological response of soft matter, in connection with the interactions. This is needed for the rational design of novel composite materials with optimized properties, which can be used in a wide range of applications from plastics to cosmetics and from food to pharmaceuticals.

2. Self-assembly and structure formation

The structural properties of soft matter systems are determined by the mesoscopic building blocks and the weak interactions between them. Soft matter composites offer a new, unique possibility of modifying and controlling this structure, and thus the mechanical, thermal, optical, rheological and dynamical properties of these materials. There are different ways of organizing soft materials: self-assembly of specifically designed building blocks, non-equilibrium structure formation by external fields, or by active biological processes. Self-assembly is mainly important in amphiphilic and biological systems. Non-equilibrium structure formation occurs in colloids or polymers in flow, but also in wormlike micelles and network-forming polymer-surfactant mixtures. Dispersing colloids in polymer matrices or at liquid interfaces are important schemes for tailoring nanocomposite properties. Soft matter concepts are also essential for understanding the complex machinery of biological systems at the cell level, in particular their non-equilibrium behaviour.

3. Slow dynamics

Both the size of the mesoscopic objects as well as their interactions give rise to slow dynamics. Particularly interesting are gelling and glass transition phenomena which are common themes for many soft matter systems. Apart from soft matter the nature of the glass transition is one of the most important and challenging open questions in condensed matter science and is also investigated in many other contexts. Also geometric or topological interactions lead to slow dynamics which are relevant for the rheological and mechanical properties of soft matter systems. As a major result, a big step towards a basic understanding of glass transition and gelling phenomena is expected relating them to molecular properties with important consequences for the other two research directions. Constitutive equations based on microscopic insights will provide predictive tools for controlling the state of a composite mixture and its flow. The increasing complexity of an environment and its impact on the slow dynamics will help to create new materials with new rheo-mechanical properties.

SoftComp
SOFT MATTER COMPOSITES

newsletter

Vacancies

Postdoctoral position at the soft matter/biology interface...

...available in autumn 2007 at the Curie Institute (Paris) to work on the interactions of toxin-coated colloids with biomimetic membranes. Candidates should preferably have experience in biofunctionalization of surfaces/colloids.

The post-doc will have the opportunity to interact with biologists at the Curie Institute and theoreticians in a very interdisciplinary environment.
Contact: patricia.bassereau@curie.fr

PhD position at Centro de Física de Materiales CSIC-UPV/EHU and Donostia International Physics Center, San Sebastián (Spain). Group of Polymer and Non-Crystalline Materials.

The aim of this thesis is to investigate, by means of computer simulations, the structural and dynamic properties of some simple models (*coarse-grained*) of soft-matter-based systems, such as complex polymer mixtures and macromolecular solutions.

Requirements: Degree in physics (or graduation before October). Basic knowledge of programming.
Starting date: September/October 2007.
The date is just approximate, but note that registration in the doctoral programme *Physics of nanostructures and advanced materials* of the University of the Basque Country is obligatory and this should be done in September.

www.sc.ehu.es/sqwpolim/pol_group.html
Contact: wabmosea@ehu.es
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Paseo Manuel de Lardizabal 4
20018 Donostia-San Sebastián
Spain

SoftComp Events for PhD Students

Date	Conference/Place	Contact
Sep 07	**European School on Rheology: Rheological Measurements** Katholieke Universiteit Leuven/Louvain Belgium	P. Moldenaers
03-14 Sep 07	**11th JCNS Laboratory Course on Neutron Scattering** Jülich/Munich Germany	D. Richter
Autumn 2007	**Lab Course on Broadband Dielectric Spectroscopy Methods in Polymers and Related Materials** Donostia/San Sebastián Spain	J. Colmenero

Personalia

On June 13th, 2007 the Institut de France awarded the **scientific prize** of the **FONDATION SIMONE ET CINO DEL DUCA** to Jacques Prost, Jean-Francois Joanny, and their collaborators Cécile Sykes and **Patricia Bassereau**.

Dr. Hiroshi Noguchi was honoured on July 2nd, 2007 with the **scientific prize** of the Japanese-German Centre, Berlin (JDZB) for his work in biophysics and soft matter, and in particular for his computer simulations, allowing a detailed investigation of flow behaviour of red blood cells, contributing to the SoftComp research programme on complex membranes (see SoftComp Newsletter No. 2). Since 2003 Dr. Hiroshi Noguchi has been working at Forschungszentrum Jülich, Institut für Festkörperforschung, Jülich, Germany.

Coming Up...

SoftComp Conferences & Workshops	Date
International Soft Matter Conference 2007 Aachen (Eurogress) · Germany Contact: J.K.G. Dhont	01-05 Oct 07
FIT: Franco-Israeli Trends 2007 The 4th Binational Franco-Israeli Conference in Soft Matter, Biophysics and Microfluidics. Biarritz · France • Contact: P. Fabre http://fit2007.crrp-bordeaux.cnrs.fr Franco-Israeli Trends 2007 CRPP Avenue A. Schweitzer 33600 Pessac · France	07-10 Oct 07
Collective Effects in Cell Biophysics Les Houches School (France) Contact: P. Bassereau and J.F. Joanny	06-11 Apr 08
Annual SoftComp Meeting Riva del Garda, Italy	**05-08 May 08**
• **NA Meetings**	05 May 08
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