
THE BRITISH SOCIETY OF RHEOLOGY

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GENERIC Structure

General equation for the nonequilibrium
reversible-irreversible coupling

$$\frac{dx}{dt} = L(x) \cdot \frac{\delta E(x)}{\delta x} + M(x) \cdot \frac{\delta S(x)}{\delta x}$$

$$L(x) \cdot \frac{\delta S(x)}{\delta x} = 0$$

L antisymmetric,
Jacobi identity

$$M(x) \cdot \frac{\delta E(x)}{\delta x} = 0$$

M Onsager/Casimir symm.,
positive-semidefinite

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EDITORIAL

SUBMISSIONS TO THE BULLETIN

Submissions to the Bulletin may be made by any practical means – post, email, disk, fax, pigeon, donkey, guide dog, *et cetera* but electronically is preferred (saves typing...). Most packages supported (Word, TeX, LaTeX, WordPerfect, ASCII, RTF) but always provide a contact name, address, e-mail, or telephone number in case of problems. The next copy date will be in January 2009 and, as always, all contributions are gratefully received. Late copy can sometimes be accommodated, however the facilities of the BSR and ESR web sites may also be appropriate. Please contact the Editor (xue-feng.yuan@manchester.ac.uk) for details.

COVER ILLUSTRATION

The cover shows a compact expression of modern nonequilibrium thermodynamics - GENERIC formalism. There are two contributions to the time-evolution equations of a set of independent variables $\mathbf{x}$ for a complete description of the nonequilibrium system (*e.g.* the mass density, the momentum density, the internal-energy density and the configurational distribution function of polymer chains, *etc.*) in the formalism: the total energy $E(\mathbf{x})$ as the generator of reversible dynamics and the entropy $S(\mathbf{x})$ as the generator of irreversible dynamics. $L(\mathbf{x})$ and $M(\mathbf{x})$ are the Poisson and friction matrices representing geometric structures and dissipative material properties. $\delta/\delta\mathbf{x}$ is functional derivatives. Together with symmetric degeneracy requirements, GENERIC provides a general structure for time-evolution equations of complex dynamic systems. Such a systematic approach can guarantee to generate a consistent set of dynamic equations involving different levels of description from microscopic to continuum. It provides a structural guidance in deriving new dynamic equations and constitutive model for multiple scale modelling of complex fluids/soft matter. A story on 10 YEARS OF GENERIC can be founded in the featured article, kindly written by one of the pioneers for GENERIC formalism and 2008 Bingham Medallist, and also a member of the British Society of Rheology, Professor Hans Christian Öttinger.

We are always looking for appropriate images for the front cover of the Bulletin and Rheology Abstracts (preferably of a rheological nature!). Please contact either Xue-Feng Yuan (xue-feng.yuan@manchester.ac.uk) or Nick Hudson (n.e.hudson@strath.ac.uk). Contributions are always welcome!

AIMS OF THE SOCIETY

The way liquids flow and solids deform affects all aspects of life.

Extraction and processing of crude oil, moulding of plastics, use of toothpaste, spreading of margarine, painting and the lubrication of joints in the human body are all examples of processes depending upon rheological behaviour. Rheology is defined as the science of the deformation and flow of matter.

If your work is concerned with rheology in any way, then you have much to gain by joining the British Society of Rheology - publications, conferences and access to fellow members who, while working in a different discipline or industry, may be facing similar problems to yours. The Society is non-profit making and is registered as a charity.

You are warmly welcome to visit our web site <http://bsr.org.uk/> or <http://innfm.swan.ac.uk/bsr/>, and to apply for membership on-line.

Sad Loss



It is with great sadness that we mourn the loss of Mr Roy Doe, a TA Instruments service engineer for over 20 years. Roy had been battling against serious illness for several years and passed away on Wednesday 25th June.

We often hear and praise those in the front line of the science of rheology, for furthering the boundaries of knowledge and understanding, but I would like to remind you that there are often unsung heroes, working hard in the background to provide the care and attention that ensures such scientific endeavours are possible. Roy was such a person, there is not a part of the world that has not been graced by Roy's exceptional skills to diagnose, resolve and even enhance the performance of the rheological products in his domain. Roy was certainly a character, someone that you remembered after just one visit and the world of rheology will seem a slightly emptier place without Roy.

Peter Hodder
TA Instruments Ltd
8th July 2008.

10 YEARS OF GENERIC

By Hans Christian Öttinger
ETH Zürich, Department of Materials, CH-8093 Zürich, Switzerland

I. BEGINNINGS



Professor Hans Christian Öttinger and his wife after the award of the 2008 Bingham Medal at the XVth International Congress on Rheology.

The origin of modern nonequilibrium thermodynamics dates back to the summer of 1983, when Miroslav Grmela introduced the idea of dissipative brackets to formulate irreversible dynamics far from equilibrium at a research conference in the mathematical sciences on fluids and plasmas in Boulder, Colorado [1]. In the following year, three classical papers on this idea appeared in *Physics Letters A* [2–4] and, in the subsequent years, the idea of combining Poisson and dissipative brackets for constructing reversible and irreversible dynamics, respectively, was further developed by Miroslav Grmela and several people stimulated by his work. A decade after the original proposal of dissipative brackets, the development was summarized, clarified and further advanced in a comprehensive textbook by Antony Beris and Brian Edwards [5].

I personally entered the irritatingly diverse field of nonequilibrium thermodynamics in 1996. Incidentally or accidentally, that was the year in which I finally decided to give up all my pathetically unskillful attempts to please other people (in science, I mean) after somehow getting tenure in a supposedly decent institution (ETH). 1996 was also the year in which Miroslav Grmela organized the first International Workshop on Nonequilibrium Thermodynamics and Complex Fluids (IWNET) in Montreal. In this first and the series of subsequent workshops in Oxford (2000), Princeton (2003), and Rhodes (2006) enormous progress toward the original goal of developing and unifying nonequilibrium thermodynamics has been made, as is documented in several special issues of the *Journal of Non-Newtonian Fluid Mechanics* [see Volumes 96 (2001) Issues 1–2, 120 (2004), and 152 (2008)]. The fifth IWNET is going to take place in Mexico in August 2009 (see www.nonequilibrium-thermodynamics.org).

II. FRAMEWORK

It was an enormous privilege for me to be introduced to the field of modern nonequilibrium thermodynamics by Miroslav Grmela. In 1996, we developed a tradition of talking for several hours on the phone every Friday, usually until I left my office at 5:17 pm (in those days, transatlantic phone calls were still luxury). The outcome of these weekly phone discussions was the formulation of the GENERIC (general equation for the nonequilibrium reversible-irreversible coupling) as a unified framework of thermodynamics in equivalent bracket and operator formulations, which was eventually published in 1997 after the sixth referee insisted on changing the fifth revision back into the original submission [6, 7]. In a geometric interpretation, a Poisson bracket translates an energy landscape into the reversible contribution to dynamics, whereas a dissipative bracket converts an entropy landscape into the additional irreversible contribution (equations are avoided here at the expense of an impertinent abuse of the front cover). In other words, the basic idea of GENERIC is that of fitting train tracks (preferably on contour lines) and rivers (preferably downhill) into the distinctive landscape of Switzerland, saving the second law of thermodynamics (“rivers never flow uphill”) by forming lakes out of rivers whenever necessary. Note that there are no train tracks and no rivers in a flat desert because they would not know where to go (the exceptional nonlocal phenomenon of rectilinear caravan motion seems to be related to the existence of oases and the finiteness of the desert, as far as I know from the movies).

The biggest innovation of GENERIC is the acronym. Whereas the same ideas and concepts were employed in the context of plasma kinetic equations already in the classical 1984 paper by Kaufman [2], the innovative acronym emphasizes that we recognized, appreciated, believed, and elaborated the full generality of these ideas. This universal character of the framework is corroborated by its derivation by means of the projection-operator technique of statistical mechanics [8, 9]. As a result, we have statistical expressions of the thermodynamic building blocks, which I regard as an integral and essential part of the full GENERIC story.

III. BOOK

When I was sentenced to a two-year term as the Chairman of the Department of Materials at ETH Zürich in 2000, I spontaneously decided to write a book on modern nonequilibrium thermodynamics. I gratefully welcomed this luring opportunity to consider writing a book as fun—compared to all the administrative work preventing any meaningful scientific activity. My goal was to present the elegant unified framework together with its statistical foundations in a textbook style with many exercises. The resulting book [10] emphasizes the structure of nonequilibrium thermodynamics and illustrates the potential of the framework through a variety of examples from rheology. Rheology is a particularly interesting playground for modern thermodynamics because, as we all know, it harbors a

variety of nonlinear phenomena that are of direct relevance to processing and go far beyond the famous theory of linear irreversible thermodynamics [11, 12].

IV. USEFULNESS

As rheologists have a massive interest in the topic, they expressed sincere recognition for GENERIC from the very beginning, but typically in a somewhat indirect form. I repeatedly received the following kind of comment: “It would be really great to have a general theory of nonequilibrium systems, but the GENERIC approach certainly cannot achieve such a grand goal and must hence be flawed for some reason. Moreover, the idea is certainly not new and probably contained somewhere in the work of Lev Landau or some other hero of physics anyway.” I learned to find this charming kind of comment very encouraging.

As there seems to be no doubt about the fundamental importance of nonequilibrium thermodynamics, we can now address the famous question [13]: “Has this field produced anything other than journal papers?” Appendix E of [10] contains an extensive but incomplete list of successful applications, and this list is growing rapidly. An early exposition of the potential of nonequilibrium thermodynamics in applied rheology was published in *Applied Rheology* [14]. I here restrict myself to some of my favorite GENERIC offsprings:

1. The formulation of a consistent reptation model incorporating anisotropic tube cross sections, double reptation, convective constraint release, and tube stretching, while avoiding the independent alignment approximation, in terms of natural GENERIC building blocks is a prototype application of the phenomenological approach, supplemented by insights from the statistical approach [15–21]. Elevation of the number of entanglements from an external parameter to a structural system variable is the next important step (work in progress).
2. As a highlight of unapplied rheology, I would like to mention the formulation of appropriate hydrodynamic equations for dissipative cosmology, galaxy formation, and transport processes in a gravitational collapse [22, 23] and the generalization of the black hole entropy to arbitrary gravitational fields [24] (“per aspera ad astra” seems to be an appropriate generic statement about nonequilibrium thermodynamics and beyond).
3. How can one distinguish glasses from supercooled melts based on static snapshots of atomistic configurations of the system? GENERIC suggests to look at the Poisson bracket as an important static fingerprint of a system [25]. Indeed, a nonaffine response to deformation due to rejuvenation, which is expressed through the Poisson bracket, reveals the approach to the glass transition as clearly as any dynamic quantity [26]. A universal rheological model of glassy behaviour has been offered [25].

4. Statistical nonequilibrium thermodynamics paves an entirely new pathway to efficient computer simulations, as sketched in the following section. The statistical approach provides the general theory of coarse graining, which may be considered as the theory of understanding by reducing problems to their essentials.

V. SIMULATIONS

With the guidance offered by nonequilibrium statistical thermodynamics, simulation techniques are elevated from brute-force computer experiments to systematic methods for extracting complete, redundancy-free and consistent coarse grained information for dynamic systems. In a recent review [27], the title of which was inspired by the hilarious British movie “Four Weddings And a Funeral” (1994), the thermodynamic approach to simulations was condensed into four lessons:

1. Identify a suitable set of relevant variables for a coarser target level of description and express them in terms of the variables of a finer source level.
2. Choose a convenient nonequilibrium ensemble, verify its equivalence with a generalized microcanonical ensemble, interpret all the Lagrange multipliers, and find their values for nonequilibrium situations of interest.
3. Calculate the static building blocks of nonequilibrium thermodynamics by the highly developed Monte Carlo methods of equilibrium statistical mechanics. Overcome the challenges implied by a wide range of scales in a problem by a balanced set of Monte Carlo moves causing configurational changes occurring on various length and time scales.
4. Evaluate the dissipative bracket by means of the Green-Kubo formula in terms of two-time correlations. As the only thermodynamic building block containing dynamic material information, its calculation requires dynamic simulation techniques. However, dynamic simulations are required only for a small fraction of the longest time scales of the system. The only goal of long-time stabilization is to conserve the chosen statistical ensemble.

These four lessons are accompanied by an important caveat [27]:

The hallmark of true and complete coarse graining is an increase of both entropy and dissipation (or friction); meaningful coarse graining techniques focus on calculating both increases or, at least, are capable of accounting for the corresponding effects.

This caveat scathes a capital sin lightheartedly committed in the molecular dynamics community in these days. Simulators try to coarse grain systems by

introducing temperature-dependent effective potentials (more precisely: free energies) for “superatoms” which typically consist of some 10 atoms. To calculate such effective potentials efficiently, “iterative Boltzmann inversion” has been developed. With this approach, one can then handle the additional entropy appropriately, but not the additional dissipation. In many cases, the effective potentials are simply used in the reversible equations of motion of classical mechanics to perform molecular dynamics simulations. Such a procedure corresponds to using a Poisson bracket and a single generator for constructing the entire coarse grained dynamics and hence proves a complete lack of understanding of the principles of nonequilibrium thermodynamics.

On the bright side, I would like to mention with greatest pleasure that several world leaders in computational science and engineering have been dragged into using the framework of statistical nonequilibrium thermodynamics as a background for guiding simulations: Juan José de Pablo [28], Vlasis Mavrantzas [29], and Martin Kröger [30]. This list should not be considered to be exclusive or complete.

VI. FUTURE

The penetration of nonequilibrium thermodynamics into rheology and other areas of application is only at its beginning. Among the key benefits from the GENERIC framework for the near future, I see the following emerging possibilities:

1. Guidance of the consistent formulation of realistic models for increasingly complex materials in terms of an increasing number of structural variables.
2. Application of boundary thermodynamics to understand and describe the physical conditions at the boundary and to develop appropriate mathematical boundary conditions to supplement successful bulk equations [31–33].
3. The development of increasingly efficient and versatile simulation methods for bridging time and length scales in science and engineering.

To be continued soon [34].

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BSR NEWS

BSR Two Gold Medals

The BSR has decided to award two Gold Medals in the forthcoming year: Professors Mike Cates (University of Edinburgh) and Tom McLeish (Universities of Leeds/Durham) will each be presented with a BSR gold medal at the European Rheology Conference in Cardiff in April 2009.

2008 BSR Annual Award

Professor Peter Olmsted from the University of Leeds is this year's recipient of the BSR Annual Award. He will receive this award, and give a lecture in the BSR midwinter meeting in December 2008.

2008 Vernon Harrison Doctoral Prize

The Vernon Harrison award subcommittee has decided that 2008 award will go to Dr Lucio Isa of Edinburgh University, supervised by Professor Wilson Poon. Dr Isa will receive the prize and present his work in the BSR midwinter meeting in December 2008. A summary of his PhD thesis is presented in this issue.

Summary of the PhD Work which won the 2008 Vernon Harrison Prize

Winner: Lucio Isa, School of Physics and Astronomy, University of Edinburgh

Title of PhD Thesis: Capillary Flow of Dense Colloidal Suspensions

This thesis investigates the flow of dense colloidal suspensions into micron-sized capillaries at the particle level. Understanding the flow of complex fluids in terms of their constituents (colloids, polymers, or surfactants) poses deep fundamental challenges, and has wide applications in many industrial processes. Through the use of a novel experimental procedure we find results contrasting with the predicted bulk rheological behaviour of dense colloidal systems and propose an alternative approach based on the analogy with granular systems. Quantitative predictions which successfully explain the data are obtained. Additionally, we report the presence of flow instabilities related to strong confinement effects.

In order to obtain quantitative information on the dynamics of the system in real time and at the single-particle level, we image the flow using a fast confocal microscope and identify the trajectories of each particle. Due to the nature of the flow, conventional techniques for locating and tracking the particles fail to yield satisfactory results. To overcome this limitation, we have developed a novel technique which allows us to successfully track the particles in strongly non-uniform flow fields. This technique offers itself as very broad instrument which can be used in a number of imaging geometries and systems and constitutes a significant advance in “rheo-imaging”. This part of the thesis has lead directly to two publications and forms the basis for numerous other works.

The main body of the thesis deals with three main aspects of the flow: concentration gradients, velocity profiles and time behaviour.

In channels less than thirty particles wide, we observe the occurrence of concentration gradients along the flow direction. The use of single-particle imaging allows us to obtain simultaneously, the local density and velocity profiles and to relate them. This constitutes a major advance compared to previous literature of colloidal channel flows, where such real-time information was not available. The main finding consists in the observation of high density regions where the velocity is uniform across the channel (“complete plugs”) and lower density regions where shear is present. The presence of interfaces between high and low density region is instrumental in understanding some features of the temporal dynamic of the flows which we will discuss later. The observed concentration profiles can be qualitatively explained by considering the relative flow between the solvent and the suspended particles.

The largest part of the thesis is devoted to the study of the velocity profiles in the lower density, sheared regions. Such velocity profiles consist of a “plug” in the

centre while shear occurs localized adjacent to the channel walls, reminiscent of yield-stress fluid behaviour. We recall that concentrated hard-spheres colloids are indeed conventionally described as yield- stress (Herschel-Bulkley) fluids for particle volume fractions above 0.58. However, the observed scaling of the velocity profiles with the flow rate strongly contrasts yield-stress fluid predictions. Instead, the velocity profiles can be captured by a theory of stress fluctuations originally developed for chute flow of dry granular media. We extend the model to our case and discuss it as a function of a series of parameters (boundary conditions, volume fraction, channel size, etc.) highlighting differences and similarities with granular media. This part of the work has lead to at least two publications and constitutes an important point to bridge between the increasingly overlapping communities of granular media and colloid science.

Finally we discuss the time behaviour of complete plug flows. Surprisingly, when the system is driven by a constant pressure difference, we observe the presence of macroscopic flow rate oscillations, consisting of cyclical jamming and unjamming of the suspension. We find that there exists a threshold value of the flow rate below which oscillations in the velocity are absent and above which their frequency scales as a power law of the flow rate. In addition to these macroscopic observations, we relate the oscillations to the microscopic behaviour at the single particle level. In particular we highlight the role played by the relative solvent flow during jamming and unjamming. These part of the thesis motivated further studies on the mechanisms behind of the oscillations which ended up revealing the crucial role played by confinement effects in our flows, both of high fundamental and practical relevance, and which have lead to at least one publication.

Report on Meeting of the International Committee of Rheology

The quadrennial meeting of the ICR took place in a waterfront restaurant overlooking Monterey Bay, during the course of the International Congress, August 5th 2008, attended by delegates from most of the member societies. Issues discussed and decisions taken were as follows.

The recently formed South African Society was represented by Paul Slatter and it was unanimously agreed to welcome them to the ICR and, for the purposes of congress site selection, the European constituency should be enlarged to be Europe and Africa. The other two constituencies remain as The Americas and Asia/Pacific, and the established rotation of congresses in the order Asia/Pacific, Americas, Europe/Africa should continue.

The proposal from the European Society of Rheology to hold the 2012 congress in Lisbon, jointly organised by the Portuguese, Spanish and Slovenian societies, was unanimously approved (August 5-12, 2012).

Individual positions were approved: Chairman - Gerry Fuller, Secretary – Manfred Wagner, IUTAM representative – Gary Leal.

Finally, after discussion on the possible coordination between the ICR and the IUTAM congress, which currently occur in the same year on a four-year cycle, it was agreed that the number of people affected by the coincidence of these congresses was too small to justify a change and therefore the present, four-yearly cycle of ICRs will continue.

Phil Banfill

August 2008

Report on the XVth International Congress on Rheology - 1

My attendance at the XVth International Congress on Rheology was a special opportunity to exchange ideas and expertise with other researchers and experts from all over the world. The Congress convenes every four years and brings together the world's leading rheologists to present the latest advances and developments in this field. The XVth International Congress on Rheology was organized by the Society of Rheology with the purpose to providing a mechanism and format for interaction and presentation of research results within the International rheological community.

The conference brought together a wide spectrum of individuals from academic, industrial, and governmental institutions whose activities include both phenomenological and molecular theories, instrumentation, the study of many types of materials such as polymers, metals, petroleum products, rubber, paint, printing ink, ceramics and glass, foods, biological materials, floor preparations and cosmetics, and a wide range of practical applications. It provided a discussion forum for the worldwide community of Engineers and Scientists in the field.

Rheology enters in some form into almost every study of material properties, and many physicists, chemists, engineers, biologists and mathematicians find a common meeting ground in The Society's meetings and publications. The meeting enhanced interactions among researchers around novel trends in theoretical and experimental investigations of rheology of materials.

The Congress included opening and closing plenary lectures and fourteen keynote lectures by eminent rheologists, contributed oral presentations organized into sixteen mini-symposia, and a poster session.

My presentation entitled **“Using hollow microcapillaries to explore the extrusion rheology of polymer films”** was of interest to some industrial and academic researchers. From a personal point of view, the opportunity to present my own research to varied audience was a magnificent opportunity.

The symposia were on the following topics: Materials, Complex Flows, Homogeneous Polymeric Systems, Heterogeneous and Self-Assembling Polymeric Systems, Bio-Rheology, Suspensions and Colloids, Surfactants, Emulsions and Foams, Granular Materials and Ageing, Microfluidics, Solids/Gels and Glasses from Soft and Composite Materials, Interfacial Rheology, Micro-Rheology, New Experimental Methods, Food Rheology, Rheology of Solids and Glasses and General Rheology.

I particularly enjoyed presentations by Arkady I. Leonov, John M. Torkelson, F. Chinesta, Balta Mena and Malcolm Mackley as their work was relevant to my own and they were presented with great style.

The international congress at Monterey was particularly memorable. It was superbly organized in an excellent venue. The weather was not particularly good and the famous west coast fog kept temperatures down. This however did not dampen spirits particularly at the beach party. The volley ball was a lot of fun; the food and music were great. Professor Fuller leading the conga around the beach was very memorable and the Karaoke was if nothing else noisy.

I found the meeting most useful as it gave me an opportunity to meet people in my field of research and also discuss my own research with them. Monterey, CA was also a fascinating place to visit and I would like to thank The British Society of Rheology for awarding me a Student Travel Bursary to make the visit possible.

Dora Iliana Medina
Department of Chemical Engineering
University of Cambridge
1st September 2008

Report on the XVth International Congress on Rheology - 2

The XVth International Congress on Rheology was held during the beautiful summer 2008, in the heart of beautiful California (USA). Monterey is a charming town located by the sea, which offers a wide range of excursions, such as diving in the enigmatic world of marine biology with Monterey's gigantic aquarium, promenades on the delightful fishermen's wharf, day trips to admire the gorgeous landscapes of Big Sur, exquisite wine tasting in the neighbouring Carmel Valley and even amazing whale watching in the bay of Monterey... Monterey is a dream place to host a conference.

The congress itself also boasted with a wide range of 'excursions' in the world of rheology, including, material processing, complex flows, microrheology, and the rheology of various types of systems; polymeric systems, suspensions and colloids, granular materials, interfacial rheology, solid and glasses etc... Being a food technologist, my main interest was in the food rheology sessions, although I did attend other presentations, for their relevance to food systems, or sometimes just out of pure curiosity.

In the food gels and perception session, several talks focused on the rheology of dough systems, from establishing a constitutive model for the rheology of dough, to the understanding the effect of the composition or the gas cell structure on the rheological behaviour. The fracture behaviour of starch gels was also presented, highlighting the influence of the cutting method or the effect of the microstructure of the gels on the fracture response. The rheology of other types of food systems

was also reviewed, for example, pear and surimi. Although the rheological properties were fully characterised, it would have been interesting to have more information on the relationship between the microstructure of the product studied and their rheological behaviour, or at least, hypotheses on it.

The other type of topics presented during the food gel and perception session dealt with the sensory properties of food in relation to their rheological behaviour. For example, the grittiness of food was related to the presence of particles that would disturb the stress field of a fluid; the mouthfeel perception of dairy emulsions was correlated with their bulk rheology and tribology; and finally the ‘body’ of wine (or its viscous mouthfeel) was attributed to subtle differences in capillary viscosity, which in turn resulted from differences in composition.

In the food dispersions session, the rheological behaviour of systems such as honey or Marmite were presented, in relation to their composition or microstructure. The rheology of coating fats was linked to their coating characteristics, including the film porosity, thickness, or resistance to abrasion. Two other talks dealt with the deformation of droplets under flow; one consisted of the deformation of an oil droplet in a viscoelastic matrix (guar gum solution), whereas the other one was on the deformation of a droplet of swollen starch granules, dispersed in an oil phase, for its relevance to the formulation of starch thickened systems. Lastly, an in-line rheometry method based on ultrasound was explained and its relevance to the processing of fluids containing large particles or fibres was demonstrated.

Finally, a ‘non-food’ presentation that stroke me was one on the shear-banding of a telechelic associative polymer material. The presentation showed that the occurrence of the shear-banding phenomena of this material was non chaotic and could be predicted using the same laws found for the occurrence of earthquakes, which could be considered to be a ‘giant’ shear-banding of earth happening on the macroscopic scale.

This conference was a rich experience on all grounds. It was not only a great opportunity to present a piece of my work, but also a unique chance to learn from rheologists from all over the world and all backgrounds. I would like to express my gratitude to T-A Instruments for having sponsored my travel grant to this conference but also those of other students. This is fantastic contribution to our learning, and to our widening horizons and ideas.

Tram-Anh Line DO
PhD student
University of Nottingham

Student Travel Bursaries

The 301st Council Meeting established the principle that student travel grants have the objective of encouraging students to disseminate their research. Applicants for a student travel bursary must be a member, may be working worldwide and presenting research at a conference, by paper or poster. The grant will be made on receipt of a report on the event.

The British Society of Rheology wishes to establish a transparent mechanism for the award of travel bursaries and to solicit applications from its student membership. Travel bursaries are available to student members of the Society to present their research at a conference that contains a strong rheological element, in situations where no other sources of funding are available to cover the whole cost of the meeting. Suitable conferences include the International Congress of Rheology, the Annual European Rheology Conference and conferences organized by the Society.

The closing dates for consideration of the award of a travel bursary are 31st March and 31st October with successful applicants notified by 30th April and 30th November, respectively. Applicants should include in their submission the name and location of the conference, the title, authors and abstract of the paper submitted to the conference, a breakdown of the projected costs of attending the meeting and a supporting letter from their research supervisor. The support of the British Society of Rheology should be mentioned in the conference presentation. The Society's logo may be used for this purpose. Payment of the bursary will be made on receipt of a report on the conference. The conference report will be published in the Bulletin of the Society.

Applications for a travel bursary should be sent to the Secretary:

Dr Helen Wilson
Department of Mathematics
University College London
Gower Street
London WC1E 6BT
United Kingdom

Tel: +44 20 7679 1302
Fax: +44 20 7383 5519
email: helen.wilson@ucl.ac.uk

Minutes of the 67th BSR Annual General Meeting The Foresight Centre, University of Liverpool

Tuesday, March 18th, 2008, starting at 4.25pm.

1. Present

The President, the Hon. Secretary and 29 members.

2. Apologies for absence

Received from Richard Buscall, Bogdan Dobraszczyk, Claudio Filippo, Phil James, Alex Lubansky, Tegwyn Perkins, James Prentice, Jason Stokes and Mike Webster.

3. Minutes of the 66th AGM

These were agreed as a true record of the meeting and signed by the President.

4. Matters arising

There were none.

5. Reports of the officers.

5.1. President

Phil Banfill expressed his pleasure at the Society's long association with science over more than 65 years, and the many illustrious names engraved on the presidential chain. He felt that the society is part of our scientific heritage, and is pleased that we can support our area of science. The society supports meetings such as this (Complex Flows of Complex Fluids, jointly with the INNFM), as well as joint enterprises with others (particularly the European society). We also support science through our various Awards, including travel awards to sponsor research students to attend conferences, and through our publications. He said that the INNFM springtime meeting has now become a tradition, and thanked Rob Poole and Marcel Escudier for organising this one. Last December a meeting on Foams and Emulsions has been held at Imperial College, attended by about 45 people. Plans for the future include the next midwinter meeting, to be held in Leeds on the theme of Microstructure and Rheology. The society has also successfully bid to host the Annual European Rheology Conference in 2009, which will be held in Cardiff in April. The Society has also been involved in the Non-Newtonian Club, and the President thanked Jason Stokes for its continued revival. There had been two successful meetings in the last year, mainly attended by younger rheologists: one at Oxford in June, the other at Port Sunlight in November. He expressed his gratitude for the continued sponsorship we receive from the rheometer manufacturers for meetings. Finally, the President expressed his thanks to all the Council members from the last year. All were mentioned individually, but particular thanks were passed to Bogdan Dobraszczyk, who is stepping down as

Bulletin Editor after 4 years (with Xue-Feng Yuan taking his place) and to Derek Bell, who is leaving Council after 4 years as a very effective liaison with our advertisers.

5.2. Treasurer

David Binding presented the Treasurer's report. He reported that we had had a successful year, making a profit of nearly £6K, which more than recovers the loss of the previous year. Much of the improvement is due to the completion of our development of the website: the costs have now reduced to a regular maintenance charge of between £1.5K-£2K per year. It should be noted that the website provides income too, and is close to its advertising covering its costs. There had been significant expenditure on Awards, which was slightly misleading as it included two Vernon Harrison Awards and two Annual Awards, with one of each carried over from the previous year. Council expenses were in line with previous recent years. The Society had bought a new computer for the Scott Blair library out of the Scott Blair fund. Anthony Pearson suggested this should be viewed as instant depreciation rather than an asset and this was agreed. All our publishing strands are now showing a profit. Rheology Reviews 2007, being slightly delayed, was misleading as more income will be recovered on it. There is a total of around £4.5K of advertising and sponsorship income: this should rise as the sponsorship of Rheology Reviews increases. In addition, the BSR midwinter meeting now provides a small profit each year of around 500. In summary, the Treasurer reported that the finances are healthy and sustainable, and that we are now in a position to offer Rheology Reviews 2007 free to all members.

The Treasurer was thanked through the chair by Nick Hudson.

5.3. Hon. Secretary

The Secretary reported that the Vernon Harrison Doctoral Prize had been awarded to Dr. Tim Reis for his work on Lattice Boltzmann Methods for Complex Flows, supervised by Tim Phillips at the University of Cardiff. He was presented with the award, and gave his lecture, at the midwinter meeting in London. At the same meeting, the Annual Award was presented to Gerry Meeten of Schlumberger, for his extensive work on industrial rheology problems, both theoretical and experimental. We made two student travel awards last year - one to Salvatore Mascia of the University of Cambridge, who presented his work on the squeeze flow rheology of highly filled suspensions at the AERC in Naples; the other to Bumroong Puangkird of the University of Swansea, to present his paper on numerical simulation of viscoelastic flow in cross-slot devices at the IWNMNNF in Rhodes in June. Finally, we introduced the BSR - TA Rheometrics poster prize at the midwinter meeting. The prize was won by Line Do of the University of Nottingham for her poster on the use of limonene to improve the texture of low-fat chocolate. She is given a travel award which will allow her to present her work at the ICR in Monterey next August.

5.4. Membership Secretary

In the absence of Phil James, the report was presented by the Secretary. She reported that the membership of the Society is currently (before the Liverpool meeting) 453, including 64 honorary members. The membership is domiciled as follows:

UK - 73%

EU - 15%

Rest of World - 12%

This includes 41 members gained through their attendance at meetings.

In addition to those 41 members, there were 13 new members; 29 members had resigned. Three members (Beazley, Overbeek and Ward) had died during the year. The membership subscriptions are slightly down on 2007 (we are working on this) - and Council is very grateful to those members who pay by Standing Order every October.

5.5. Bulletin Editor

In the absence of Bogdan Dobraszczyk, the report was presented by the President. He reported that the Bulletin, at 40 pages three times a year, was still a good read, with a nice mix of citations for awards, reports of conferences and other events. As it is a few months in production, the conference diary is difficult to keep up to date, but should be viewed merely as a supplement to the website. He expressed apologies to Rob Poole, Manuel Alves and Paolo Oliveira for the lack of acknowledgment of their work (cover of the current bulletin) which is fully described but uncredited.

5.6. Abstracts Editor

Nick Hudson reported that we are still producing Rheology Abstracts, because there are still a number of institutions buying it, and it is a small earner for the society. There are now only 4 abstractors (abstracts are mostly gathered from other sources) and this may be something for Council to consider over the next year or so.

6. Officers and Council members.

The President was commencing the second year of his term. There being no further nominations for Officer posts, the Officers nominated by Council were approved by postal and electronic voting and unanimously by those voting at the meeting. An extra nomination for Ordinary member of Council was received - Steve Goodyer - so an election was held. The Council for 2008-9 was elected as follows:

Hon. Secretary	Dr. Helen Wilson
Hon. Treasurer	Dr. Dave Binding
Membership Secretary	Dr. Phil James
Bulletin Editor	Dr. Xue-Feng Yuan



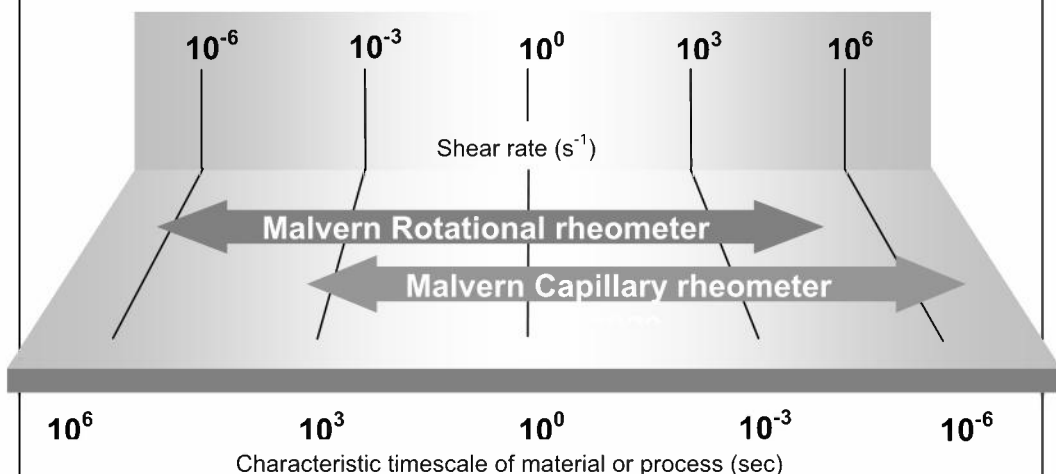
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Abstracts Editor

Dr. Nick Hudson

Ordinary Members of Council

Dr. Bogdan Dobraszczyk

Dr. John Embery

Professor Tim Phillips

Dr. Jason Stokes

Professor Mike Webster

Professor Rhodri Williams

7. Any other business

There was none.

Date of next meeting. The 68th Annual General Meeting of the Society would be held in April 2009 in Cardiff.

There being no other business the meeting closed at 5pm.

H.J. Wilson, Hon. Secretary

P.F.G. Banfill, President.

Commentary on the 323rd Council Meeting of the BSR University of Liverpool, 19th March 2008

Liverpool – March 2008. The Annual General Meeting following the very successful meeting honouring Prof Jim Oldroyd had just finished, and the delegates were making their way home. All except the Council members, who had to grab their cases and move to another building. The first thing that a number of them did was pounce on the lunch that had been laid out for us. It appeared that they were starving, not having had any breakfast (apparently, there had been an overnight fire in the kitchen at the hotel at which they were staying!).

Our President then informed us of the untimely death of one of his predecessors, Prof Eirean Jones of Plymouth University. I had known Eirean for over thirty years, so this was quite a shock. Our usual respectful silence was observed.

We then got down to the business, starting with the previous meeting minutes & actions (or inactions in some cases!). Shall we award Gold Medals this year, and if so, to whom? We need to decide on the Annual Awardee – must get some citations. There is a plan to digitise the Scott Blair Collection – what progress?

The Officers then gave their reports. All seemed to be managing their briefs well, though some extra information was required in certain areas; to be obtained for the next meeting or promulgated by email.

As regards the Non-Newtonian Club, one or two venues/sponsors were mentioned – let us hope that they came to fruition. The Club is an ideal forum for academia to meet industry, in an informal (and free) atmosphere, and discuss mutual problems/solutions.

The planning of Scientific Meetings up to the Spring of 2010 was then undertaken – phew!

Finally, as it was half way through the current Presidency, we had to start thinking about the next incumbent. A name was mentioned, and he/she will be approached, with a view to nomination at the next AGM.

We then all scattered to the 4 corners of the UK.

Nick Hudson

Commentary on the 324th Council Meeting of the BSR Herriot-Watt University, September 9th 2008

Six people met at Heriot-Watt University for this Council Meeting – rather fewer than expected, due to late summer issues in some members' lives. I was in the chair, Helen Wilson was secretary, Nick Hudson, Phil James and Xue-Feng Yuan were here, but where was Steve Goodyer, whom we had seen the previous evening? I should mention that we agreed to co-opt Steve to the Council because he had offered to join at the AGM in March but for the first time in many years there had been an election for members, so he hadn't been able to join us. Bogdan Dobraszczyk had subsequently resigned from Council, leaving us with a vacancy, which Steve had agreed to fill until the next AGM. But where was he? When he arrived at 1020 it transpired that he had opened his suitcase to find no shirt, so had gone to an appropriate emporium on Princes Street and bought one, which they had ironed for him there and then. Such service!

We considered matters large and small, important and trivial, expensive and cheap, all affecting the smooth running of the Society. Helen produces a helpful list of actions following each meeting, so it is easy to check that you have done what you promised. The Awards sub-committee had met and agreed the recipients of the Gold Medal and Annual Awards, and identified the next President, and we reviewed the timings for the Vernon Harrison PhD Award. We bemoaned the rise in the price of gold which will inflate the cost of the medals to be struck soon. We noted changes to the membership of Council, with Rhodri Williams and Jason Stokes standing down at the next AGM, and identified candidates to replace them (if willing). We heard about progress with the membership and subscriptions from Phil James, noting three deaths, and discussed the management implications of automatically enrolling as members those who attend BSR scientific meetings. This membership is for one year and not, as one student asked, recurrent if he attends another meeting in the following year. There is a perennial problem of tracking payments, tracking down members who continue to pay out of date subscription rates by bank standing order. (This accounts for the annual income often being a prime number of pounds, even when subscriptions are all divisible by five).

We had made two awards to students to attend the International Congress in Monterey but were still awaiting their reports for the Bulletin. In fact Xue-Feng was worried about contents for the Bulletin and we made various suggestions. We try to keep the Bulletin interesting as well as factually informative, so it is good to have an article of some significance. Since 2009 represents volume 50, we

discussed ideas for historical articles to mark the anniversary. Rheology Abstracts is our other serial publication, and Nick brought us up to date with the use being made of the abstract facility on the website, currently showing 150 visits per month, which we thought was reasonable. However, the big problem is collecting and collating the abstracts themselves, which is done by a very few people. Since institutions have been finding their library budgets under pressure, there is a tendency for people to use other abstracting services, and circulation has been dropping.

Dave Binding reported in his absence that Rheology Reviews is to be issued as a combined 2007-08 volume, partly because some significant contributions for 2007 had been delayed, and this decision solved the problem of one issue seeming to be thin. More important is that he feels forced, by pressures of other work, to withdraw from the co-editorship. This gives us a headache as Roland Keunings, the other co-editor, is heavily involved with co-editorship of the Journal of Non-Newtonian Fluid Mechanics. We discussed this and agreed that I should liaise direct with all the parties, and bring a suggested strategy to the next meeting.

Scientific meetings are the lifeblood of the Society and we noted the arrangements for the mid-winter meeting in Leeds and the progress of the European Conference in Cardiff. We had been invited to take part in the IUPAC World Polymer Congress in Glasgow in 2010 and we spent a productive few minutes improving my draft programme. With Jason Stokes moving back to Australia, we will need to replace his role with the Non-Newtonian Club, which he has successfully revived. A meeting has been arranged in Birmingham in October and we agreed to organise another in June 2009, followed by October 2009, thereafter settling down to a twice yearly event.

The meeting closed at 1245 for a sandwich lunch, leaving plenty of time for people to travel home.

Phil Banfill



The Non-Newtonian Club (NNC) is an informal rheology discussion group which provides low-cost, informal, one-day meetings which provide an excellent forum for industrial and academic rheologists to meet together informally to present work in progress, raising key needs and concerns, and discussing unresolved practical and modelling issues that may be inhibited at more formal conferences. The agenda of the most recent BSR NNC meeting and the corresponding abstracts can be found at <http://innfm.swan.ac.uk/bsr/frontend/nonnewtonianclub.asp>.

The Non-Newtonian Club Meetings are held 2 - 3 times a year and provide a forum for those practicing rheology to meet. Presentations (typically 20-30 minutes) are made by academic and industry-based scientists, as well as young scientists, presenting on a range of topics that involve rheology in a relatively informal and friendly environment. To encourage phd students and 'young' scientists to present, we offer an award for the best presentation from phd students or 'young' scientists. We endeavour to keep these meetings free. Should you wish to host, sponsor, or participate in such an event, please let me know.

Jason Stokes

Report on the 5th BSR Non-Newtonian Club Meeting

The 5th meeting of the Non-Newtonian Club (NNC), organised by the British Society of Rheology (BSR), was held in the Centre for Science at Extreme Conditions in Edinburgh on Thursday July 3rd 2008. It was hosted by Job Thijssen from the School of Physics and Astronomy, The University of Edinburgh. This time, approximately 35 people attended the meeting, some of them being from as far South as Liverpool and London or as far West as Dublin!

After some coffee, tea and biscuits, especially for those who were in need of a kick-start, it was BSR President Phil Banfill (Heriot-Watt University) who kicked off the meeting with a few introductory words, with which he emphasised the importance of applicable rheology. He reminisced that one of the reasons to set up the NNC meetings was to promote applicable rheology by bringing together people from both academia and industry. The next speaker, Nick Hudson from Strathclyde University in Glasgow, continued along that track by discussing the importance of extensional or elongational deformation rather than shear deformation in industrially important processes. Not only did his talk lead to considerations on what word for 'extensional' to use on which continent, it also showed that some of the rheology apparatus that is developed by academics does get commercialised, though it may take a few years before one can buy it off the shelf.

Next up was Denis Weaire from Trinity College Dublin. He showed some results, mainly from simulations but supported by some really nice experimental movies, on the rheology of 2D foams. He explained that one of the major differences between 2D and 3D foams is that 2D foam has an extra feature, namely the drag on the containing walls. His talk invited the audience to reconsider the importance of constitutive relations and whether it is relevant at all, from a practical point of view, to look for general constitutive relations. The last speaker of the morning session was Oliver Henrich (University of Edinburgh), who started by introducing the framework of Mode Coupling Theory and an extension that has recently been developed to include systems under steady shear. He showed some results for a 2D hard disc fluid in plain Couette flow, predicting a distortion of the static structure factor. When asked whether it would be worthwhile to perform (challenging) experiments in 2D to confirm this prediction or whether it would be more sensible to wait for 3D simulations, the speaker replied that the latter would probably make more sense, which seemed to be the consensus among the experts in the audience as well.

Of course, all this food for thought demanded some actual food - lunchtime! It was generally agreed upon, perhaps even unanimously, that lunch was terrific. Thus, a big thank you to TA Instruments for sponsoring the catering. Needless to say that

this tasty break was an excellent excuse to meet up with old colleagues or to meet some new people.

All carbohydrate reserves replenished, the audience was ready to take on the first half of the afternoon session, which started with a presentation on micro-rheology by Andrew Harrison (University of Edinburgh). He showed that it is possible to measure the viscosity of colloidal systems by dragging a single colloid through it using optical tweezers. There appeared to be a very decent match between micro-rheology and simulations. The session was continued by Volfango Bertola (University of Edinburgh), who discussed a subject of both academic and practical interest – the impact of a liquid drop on a solid surface. Apart from being relevant, the results presented were also highly entertaining, as several movies of sticking, bouncing and splashing droplets on heated and non-heated surfaces were projected onto the screen.



Fig 1: Kalliopi Dodou from the University of Sunderland tells the audience about the importance of rheology in patches for drug delivery.

As some pharmaceuticals are applied to the skin as creams, it is no surprise that rheology is an important aspect in pharmacy as well. This was confirmed by Kalliopi Dodou from the University of Sunderland (see Fig. 1), who talked about transdermal patch systems. She explained that it would be useful to incorporate drugs in the adhesive layer of the patch instead of in a separate layer. Subsequently

she showed results on the determination of viscoelastic parameters of high and low tack silicone adhesives both before and after the incorporation of drugs. Since some people may have been craving for caffeine near the end of this rather long session, Lucio Isa from The University of Edinburgh did a valiant and successful attempt at getting the audience excited about his research on the capillary flow of concentrated colloidal suspensions. His results clearly demonstrated that a combination of rheology and confocal microscopy can be a very powerful tool, even for high shear rates, for which particle tracking becomes non-trivial. In the very last talk of the meeting, his colleague Rut Besseling used a similar combination of cone-plate rheometry and microscopy to study slip and flow of colloidal hard-sphere glasses. What was especially striking in his presentation was the crucial importance of the nature of the boundary conditions, i.e. whether smooth or rough walls were used in the experiments.



Figure 2: Jason Stokes (right) congratulates Oliver Henrich (left) from The University of Edinburgh with his 'young researchers award'.

Following Lucio's talk, there was a refreshing cup of tea and some sugar in the form of cookies. Once back in the seminar room, Jason Stokes (Unilever) took the floor. As the NNC meetings are a relatively informal forum, they are also an excellent opportunity for young researchers to present their work, which the BSR tries to encourage by offering an award for the best presentation by a PhD student or young scientist. This year, it was agreed upon by the jury that the prize should go to Oliver Henrich from The University of Edinburgh. He managed to present a

clear and coherent story about his results obtained using Mode Coupling Theory (MCT), which is challenging as MCT is a rather technical and complicated subject. In addition, he had perfectly timed his presentation, which is a very useful skill at conferences! Fig. 2 shows Jason congratulating Oliver with his award and the corresponding prize – a copy of the *Rheology Review* series (2003-2007).

After the award ceremony, it was up to Amanda Wright from Strathclyde University to get the audience back on track with her contribution on an optical trapping technique for measuring the viscosity of the vitreous humour. Although her results were fairly preliminary, she could already show that there is a significant difference in the viscosity of fresh and frozen vitreous samples. Although some of the concepts of micro-rheology had already been introduced in an earlier talk by Andrew, it became quite clear that studying vitreous humour is a different ballgame. For example, one of the questions from the audience set off an intriguing discussion on sample preparation, which involved rabbit eyes and a hook. Fortunately, with a modest amount of foresight, the organisers had decided to put Amanda's talk after lunch.

In short, this fifth BSR NNC meeting brought together researchers who practise rheology, both from industry and academia, both experienced and slightly less experienced, which is what these meetings are all about. There was a good mix of presenters, whose contributions led to many open and interesting discussions. Moreover, the excellent food that was offered during lunch provided the right atmosphere for catching up with old colleagues and for meeting some new people as well.

The next NNC meeting will be held the 21st of October 2008. It is to be hosted by Serafim Bakalis (s.bakalis@bham.ac.uk) at the University of Birmingham. If you would like to sponsor this event, please contact Jason (Jason.Stokes@unilever.com). Anyone who wishes to present at the upcoming NNC meeting should contact either Jason or Serafim. Please note that contributions are welcome from all those that practise rheology – experimentalists, simulators, theorists (alphabetical order), whether from industry or academia, whether experienced or not.

Job Thijssen
Edinburgh, August 1st 2008

The 5th Annual European Rheology Conference (AERC)

Cardiff, UK

15-17 April 2009

AERC 2009 is being organized by the INNFM (Wales) and the BSR in Cardiff, the capital city of Wales. The aim of AERC 2009 is to contribute to the advancement of Rheology by bringing together interested researchers from Europe and the rest of the world, and bridging traditional themes with modern trends.

Following the tradition of previous European Rheology meetings, AERC 2009 will be a three day conference split into symposia that reflect mainstream or emerging areas of Rheology. There will be minisymposia on blends, copolymers and nanocomposites; process modelling; rheometry and beyond: advanced experimental methods; interfacial phenomena, surfactants and foams; suspensions and colloids; viscoplasticity, solids rheology; biopolymers, biorheology and food rheology; constitutive modelling; non-Newtonian fluid mechanics; computational modelling; flow-induced phase transitions and instabilities; industrial rheology and processing.

Cardiff is home to many national institutions including the National Museum of Wales and the much-admired Millennium Stadium. The city centre skyline is testimony to its heritage and ambition, with landmark buildings ranging from the ornate civic centre to the historic Cardiff Castle. Cardiff is well established as 'Europe's Youngest Capital' but its history dates back more than 2000 years to the Romans. It was once one of the busiest ports in the world, exporting the coal which fuelled the industrial revolution.

Plenary Speakers

Christian Bailly (Universite catholique de Louvain, Belgium)

Jae Hyun (Korea University, Korea)

Gareth McKinley (Massachussetts Institute of Technology, USA)

BSR Gold Medal Lectures

Mike Cates (University of Edinburgh)

Tom McLeish (Durham University)

In addition, the meeting will include the 2009 Weissenberg Award Lecture.

Keynote Speakers

The follow keynote speakers have been confirmed for the conference (more to follow):

Patrick Anderson (TU Eindhoven, The Netherlands)

Michel Cloitre (ESPCI-CNRS, Paris, France)

Ian Frigaard (University of British Columbia, Canada)

Cris Gallegos (Universidad de Huelva, Spain)

Michael Graham (University of Wisconsin, Madison, USA)

Bamin Khomami (University of Tennessee, USA)

Rudy Koopmans (Dow Europe, Switzerland)

Kurt Kremer (Max Planck Institute, Mainz, Germany)

Malcolm Mackley (University of Cambridge, UK)

Mario Minale (Seconda Universita di Napoli, Italy)

Dave Weitz (Harvard University, USA)

Key Deadlines

Abstract submission for oral presentations: December 5, 2008

Notification of authors (oral): January 16, 2008

Abstract submission for poster presentations: December 12, 2008

Notification of authors (posters): January 23, 2009

Deadline for early registration: February 20, 2009

Deadline for registration: March 13, 2009

For more information see:

<http://www.rheology-esr.org/AERC/2009>

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Customers now can select between three UV-measuring set-ups:

- The standard version of an UV-measuring cell can be mounted onto a temperature control unit (liquid, electrical or Peltier plate) and is suitable for UV -curing materials such as inks at ambient temperature.
- An UV-cell for thermal assisted curing processes at higher temperatures available for the Thermo Scientific HAAKE MARS. It is integrated into the rheometer's Controlled Test Chamber (CTC) and covers a temperature range from -150°C to 600°C.
- A customizable UV -cell with freely configurable distances for optical components such as light guides, condensers and glass plates simulates the arrangements of the optical components in the production process, e.g. for contact lenses.

A commercially available light source can be attached and triggered via the Thermo Scientific HAAKE RheoWin measuring and evaluation software. Applications such as powder coatings, adhesives, sealants, soldering materials, and inks or contact lenses are supported with these measuring cells.

2. Thermo Fisher Scientific Launches New Tribology Cell for its Rheometer Line

Thermo Fisher Scientific Inc. has launched a new tribology cell for its rheometer product line. Rheometers with a normal force sensor like the Thermo Scientific HAAKE MARS or Thermo Scientific HAAKE RheoStress 6000 are now capable of analyzing a bearing material's tribological behaviour.

Tribological interactions occur whenever two or more materials slide or rub over another. These have a huge impact on bearing design, affecting disciplines from mechanical to medical engineering, industries such as aerospace and defence as well as drive and control technology. Even the development of cosmetics, such as

lipsticks, hair conditioners and shampoos, benefits from a better understanding of surface engineering processes.

The tribology cell for the Thermo Scientific rheometers consists of a lower and an upper measuring geometry made of stainless steel. The lower one is designed as a reservoir and enables friction measurements of bearing materials with and without lubricant. The counterpart is equipped with a flexible shaft to ensure the concentric position of a ball made of steel or other materials, e.g. ceramic. As it is recommended to perform any test with a new ball, the measuring cell design makes sure that the ball can be easily and quickly exchanged. The measuring cell can be integrated into the rheometer's Control Test Chamber or into a Peltier temperature control unit for temperature-dependent tests between - 40°C and 200°C.

By using the Thermo Scientific HAAKE RheoWin measuring and evaluation software for rheometers, a fully automated procedure can be defined to measure the tribological behaviour of material combinations with or without lubrication.

3. Thermo Fisher Scientific Extends Polymer Application Range For Its High End Rheometer Platform

Thermo Fisher Scientific has launched a new accessory for its Thermo Scientific HAAKE MARS rheometer platform. The SER (Sentmanat Extension Rheometer) system extends a conventional steady rotational rheometer into a robust extensional rheometer for melts and semi-solids.

The SER system, exclusively built by Xpansion Instruments, was developed by Dr. Martin Sentmanat and can be adapted to the HAAKE MARS rheometer. The measuring principle is based on clamping a sample between two counter rotating wind-up drums. Measurements in controlled extensional rate mode as well as controlled tensile stress mode are both supported. In addition to the uniaxial extension, the system also supports solid tensile testing, tear and peel testing, as well as friction testing. The adapted SER system covers an operating temperature range from 0°C to 250°C. Combined with the HAAKE MARS Controlled Test Chamber (CTC), fast temperature changes and uniform temperature distribution within the sample is guaranteed. The SER platform is fully integrated into the Thermo Scientific HAAKE RheoWin measuring and evaluation software for Thermo Scientific viscometers and rheometers.

The recently launched RheoScope HT (High Temperature) module simultaneously records rheological properties and changes in the microscopic structure of a tested sample up to high temperatures. By bringing together rheological measurements with optical analysis, microstructures can be analyzed visually to obtain more information about a sample's mechanical properties based on a more detailed analysis, such as the melting or crystallization behaviour of polymers.

Key features of the Thermo Scientific HAAKE RheoScope HT module for high temperatures:

- Fully integrated into the HAAKE MARS rheometer platform
- Temperature range from -5 °C to 300 °C
- Object lens, polarizer, and camera control via HAAKE RheoWin software
- Online display of data, video sequences and storage for later analysis
- Image analysis software for the determination of particle size, particle size distribution and for structural analysis

More information about HAAKE MARS rheometer, its accessories and application reports can be found from

<http://www.thermo.com/com/cda/article/general/0,2259,1083,00.html>

Anton Paar

1. Something Your Rheometer Can't Do?

MCR is an abbreviation for Modular Compact Rheometer. The system incorporates the widest range of options and heating accessories of any rotational rheometer as well as state of the art performance. We have introduced a multitude of accessories to the market over the years, many of them in cooperation with universities and industry. If there is something that your rheometer can't do or something that doesn't appear possible please contact us to see if we can provide a solution.

The listing below describes just some of the many accessories available for this most capable of rheometers:

Electrically Heated Cylinders (300°C) and Plates with Hoods (350,400°C)

Peltier Plate and Hood (120,200°C)

Convection Ovens (450; 600;1,000°C)

Pressure Cells (4 models)

Solid Torsion Bar Fixture

UXF (Universal Extensional Fixture)

Magneto Rheological Device

Interfacial Rheology System

Ball Measuring System

Cup Holder

Customized Geometries& Adapters

Rheomicroscopy

Peltier Cylinders (200°C)

Starch Cell (160°C)

UV Cells

Film / fibre Fixture

SER (Extensional Fixture)

Electro Rheological Device

Tribology Cell

Disposable plates/cylinders Flexible

TruGap™ (gap measurement)

Immobilisation Cell

Small Angle Light Scattering

X-Ray Scattering
Dynamic Optical Rheo Analyser
Automatic Sample Changer

Neutron Scattering
Dielectric Cell
High Throughput Rheometer

Anton Paar are keen to promote the science of rheology, and in the first 6 months of 2008 we have installed an MCR rheometer in at least one University in the UK every month. In order to celebrate this achievement we are offering several copies of "The Rheology Handbook" to BSR members and their colleagues free of charge. This book is written by our own Thomas Mezger and is an ideal reference book for budding rheologists. In order to be entered into the draw for a free book please email: steve.goodyer@anton-paar.com with a brief description of your interests in rheology along with your University / Business address.

2. Tenth Rheology Workshop - December 3rd-4th, 2008

December sees the 10th UK Rheology Workshop taking place at our UK headquarters in Hertford. This course is popular with newcomers to the subject as well as those with several years experience who wish to broaden their knowledge.

Delegates receive a copy of "The Rheology Handbook" by main speaker Thomas Mezger as well a course folder with all overheads printed in colour. Two practical sessions are organised giving students the opportunity to run samples in the presence of experienced rheometer users. Discounted rates are available for students and BSR members.

3. Academic Sales Program

Do you or your students require a rheometer? Anton Paar offer special sales programs tailored to your needs incorporating academic discount, enhanced warranty and after sales support.

For further information on any of the above items please contact: steve.goodyer@anton-paar.com or telephone Anton Paar on (01992)514730.

Celsum Technologies

Celsum Technologies Ltd has successfully refurbished two Polymer Laboratories' ACER 2000 capillary extrusion rheometers, one, a remote controlled version, for a major aerospace and defence company, the other with Gammadot Rheology and Testing Consultancy.

Additionally, Celsum Technologies is working with De Montfort University to build a miniature capillary rheometer for use in a research project to develop

extrudable ceramic pastes for rapid prototyping machines. The instrument uses a computer-controlled syringe pump to provide a controllable range of piston speeds, and has a 14mm diameter barrel fitted with a sub-miniature (3mm diameter) pressure transducer. The capillaries are adapted from Luer-fitting hypodermic needles.

Gammadot Rheology

Gammadot Rheology is establishing a new Centre for Cure. This has at its core, existing instrumentation such as a refurbished Monsanto R100 Oscillating Disc Rheometer and a Reologica ViscoTech Controlled Stress Rheometer (with disposable sample plates), alongside the latest instrumentation from Polymatrix Ltd – the PM340 Series Phase Shift Curemeter. Gammadot was selected by Polymatrix to assist in the development of this instrument and has become the first test house to have a unit on site.

The R100 ODR is, of course, the workhorse of rubber cure monitoring, whilst the Gammadot-designed disposable plate/plate measurement system for the Viscotech rheometer brings research-grade instrumentation to cure-reaction studies. Together with the PM340 PSC, which is especially suited to curing liquids, these three instruments can provide cure monitoring for the full range of polymer types – whether rubber or plastic, liquid or solid, flexible, rigid or foamed.

The PM340 PSC breaks new ground in cure monitoring in that it can deliver state of cure in real time. There is no need to wait until the cure is over to establish progress at an intermediate stage. The approach also dispenses with the need to assume zero cure at the start. Putting numbers to the initial state of cure makes the determination of shelf life simple and routine. Indeed, simplicity is at the heart of this new technique which seeks to demystify cure assessment. We await your samples.

The control of cure embraces a number of challenges – not the least being processability in the early stages of cure. Problems may manifest themselves in a variety of ways, and the core instrumentation described is backed up by a host of other characterisation techniques. These include: capillary & rotational rheometry, Brookfield viscometry & thermal analysis. The Centre for Cure at Gammadot provides a comprehensive testing facility – a true one-stop shop for problems of flow and cure.

Further details can be obtained from Mark C Edwards via Email: medwards@gammadot.com or Tel: 01939 291677.

Malvern Instruments

Malvern Kinexus 'redefines the rheometer'

Radical new platform designed from the ground up delivers intelligent rheology solutions

3 September 2008: Malvern, UK: Malvern Instruments has launched Kinexus, the radical new rotational rheometer platform whose development has been shaped by extensive market research and a fresh approach to addressing the real needs of users.

Designed entirely from the ground up, Kinexus redefines the rheometer. It enables users to spend less time learning how to interact with their system and more time investigating ways to characterize and enhance a material's performance.

Kinexus incorporates technological innovations in the most critical areas of rheometer design, from sample preparation and loading, through measurement set-up and operation, to data analysis and reporting. Adaptive intelligence allows Kinexus to actively guide users at every stage.

Fully integrated into Malvern's materials characterization range, Kinexus delivers high performance measurement supported worldwide by experts in rheology applications, and informed by the company's expertise in complex materials, including particulate, macromolecular and multiphase systems.

Two systems will be available at launch – **Kinexus pro**, a high end rheometer suitable for a wide variety of routine and research applications, and **Kinexus ultra**, for even the most demanding low torque applications, such as weakly-structured and small volume sample measurements.

Applications-led interface

Kinexus is highly flexible and easy to expand, ready for further evolution as new applications emerge. A true applications-led interface revolutionises and eases user interaction, bringing 'expert system' guidance and Standard Operating Procedure-driven processes to rheological measurement. At the same time a unique and intelligent sample loading system takes all the guesswork and error out of this fundamental and critically important process, for accurate results every time.

rSpace

Central to Kinexus is rSpace, an intelligent software system that invites users to work at the level most appropriate to them. This might be to *solve* a material or process problem with an application-led approach, *experiment* using a library of

established rheological methodologies, or *design* tests from scratch for the ultimate flexibility in rheological measurement and analysis.

rMotion

Pivotal to the new technology integrated throughout the Kinexus rheometer is the rMotion drive. This dynamically optimised motor has a unique adaptive air bearing that automatically configures its operation according to test conditions. Across all material types, from solids to weakly-structured low viscosity samples to systems with critical time-dependent behaviour, rMotion allows Kinexus to capture the true material properties.

Plug and play

Newly-designed environmental controllers and geometries for Kinexus are truly ‘plug and play’, so setting up the rheometer to meet test requirements has never been easier. Results and analysis can be tailored specifically to a particular measurement, material type or application.

For details of how to redefine your rheology measurements visit www.malvern.com/kinexus

Malvern – a driving force for rheology

CONFERENCE DIARY

2008		CONFERENCES & MEETINGS
15-16 December Leeds		Microstructure and Rheology - BSR Midwinter Meeting Dr John Embery, School of Physics & Astronomy, University of Leeds, West Yorkshire LS2 9JT. Email: J.Embery@leeds.ac.uk
2009		CONFERENCES & MEETINGS
2-5 February Chamonix France		De Gennes Discussion Conference: de Gennes pioneering work in rheology and recent developments from reptation to glassy materials Chair persons: P. Coussot, Université Paris-EST N. El Kissi, Université de Grenoble J-F. Tassin, Université du Maine Contacts: secretary@degennesconference.fr http://www.degennesconference.fr/
15-17 April Cardiff		5th Annual European Rheology Conference (AERC 2009) Prof Timothy N. Phillips, Cardiff School of Mathematics, Cardiff University, Senghennydd Road, Cardiff CF24 4AG. Tel: 02920 874194 ; Fax: 02920 874199 PhillipsTN@cardiff.ac.uk http://www.rheology-esr.org/AERC/2009/
10-13 May Rome Italy		ICheaP9: the 9th International Conference on Chemical and Process Engineering Prof. Sauro Pierucci, (ICheaP-9 Conference Chair) AIDIC Conference Department, Via Giuseppe Colombo 81A, I-20133 Milano, Italy Tel. +39-02-70608276, Fax. +39-02-59610042 E-mail: icheap9@aidic.it ; http://www.aidic.it/icheap9
15-18 June Zurich Switzerland		5th International Symposium on Food Rheology and Structure Zurich, Switzerland - Peter Fischer - x41-44-6325349 x41-44-6321155 - secretary@isfrs.ethz.ch - www.isfrs.ethz.ch
20-22 July Groningen The Netherlands		Faraday Discussion 144: Multiscale Modelling of Soft Matter Chair of the Organizing committee Dr Mark Wilson, Department of Chemistry, University of Durham South Road, Durham, DH1 3LE Tel: +44 (0) 191 334 2144; Fax: +44 (0) 191 384 4737 http://www.rsc.org/ConferencesAndEvents/RSCConferences/FD144/index.asp
18-22 October Madison Wisconsin USA		81st Annual Meeting of The Society of Rheology Professor A. Jeffrey Giacomin, Rheology Research Centre, the University of Wisconsin-Madison, Mechanical Engineering Building, 1513 University Avenue, Madison, Wisconsin 53706-1572, USA. Email: giacomin@wisc.edu . Conference website: http://rrc.engr.wisc.edu/sor2009.html

2010 CONFERENCES & MEETINGS	
29-31 March Lake Vyrnwy Wales	Institute of Non-Newtonian Fluid Mechanics Easter Meeting
11-16 July Glasgow	IUPAC 2010 World Polymer Congress (Macro2010) Contact: Professor Peter A. Lovell, School of Materials, the University of Manchester, email: pete.lovell@manchester.ac.uk ; Tel: +44(0)161 306 3568; Fax: +44(0)161 306 3586.
1-6 August Sapporo Japan	5th Pacific Rim Conference on Rheology Hokkaido University, Sapporo, Hokkaido, Japan Conference Website: http://prcr2010.com
18-22 October Santa Fe USA	82nd Annual Meeting of the Society of Rheology Conference Website: http://www.rheology.org

2008 COURSES & WORKSHOPS	
3-4, December Hertford	Rheology Workshop Steve Goodyer, Anton Paar Ltd, 13, Harforde Court, John Tate Road, Hertford, SG13 7Q T: +44 (0)1992 514730; F: +44 (0)1992 514739 E: steve.goodyer@anton-paar.com

2009 COURSES & WORKSHOPS	
13-16 Jan Glasgow Scotland	Process Rheology: For further information, contact Dr N E Hudson, Dept of Pure & Applied Chemistry, University of Strathclyde, 295 Cathedral Street, Glasgow G1 1XL. Tel: +44 141 5482162; Fax: +44 141 5484822; e-mail: n.e.hudson@strath.ac.uk
2-5 Jun Glasgow Scotland	Process Rheology: For further information, contact Dr N E Hudson, Dept of Pure & Applied Chemistry, University of Strathclyde, 295 Cathedral Street, Glasgow G1 1XL. Tel: +44 141 5482162; Fax: +44 141 5484822; e-mail: n.e.hudson@strath.ac.uk
24-28, August Cuernavaca/ Termixco, Mexico	5th International Workshop on Non-equilibrium Thermodynamics IWNET 2009 Local organizers: Mariano Lopez de Haro, Miguel Angel Olivares, Federico Vazquez Hurtado Tentative topics: Interfacial phenomena, Biological systems, Fluctuations, Small systems, Complex systems, Granular matter. Website: http://www.nonequilibrium-thermodynamics.ethz.ch/
October Nottingham University	Rheology Workshop Steve Goodyer, Anton Paar Ltd, 13, Harforde Court, John Tate Road, Hertford, SG13 7Q T: +44 (0)1992 514730; F: +44 (0)1992 514739 E: steve.goodyer@anton-paar.com



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