User Seminar of 2-D and 3-D Rheology of Fluid Systems

Berlin-Adlershof, Germany
January 16–17, 2007

A new type of user seminars, dedicated to the rheology of structured bulk phases and two-dimensional interfacial layers, was organised by Anton Paar Germany GmbH (Ostfildern, www.anton-paar.com) and SINTERFACE Technologies (Berlin, www.sinterface.com) in Berlin-Adlershof. The meeting venue was chosen on the science and technology park WISTA (http://www.adlershof.de/) located in the south of Berlin and ranking among the 15 largest science and technology parks worldwide.

In order to provide information on the fundamentals of rheology along with case studies from various fields of application, the organisers worked in close cooperation with the Technical University Berlin, University Potsdam and the Max-Planck-Institute for Colloids and Interfaces in Potsdam, and lecturers from industrial research departments. As most of the about 60 participants came from research and industrial institutions in Austria, Germany and Switzerland, the lectures were given in German.

The expertise of the organisers, lecturers and participants demonstrates the large overlap between 2D and 3D rheology. This overlap can be found in the principles of rheology based on analogues like the spring and dashpot, standing for the elastic and viscous components of the complex rheological behaviour of a piece of matter, equally used in bulk and surface rheology.

The seminar gave an introduction into the fundamental knowledge needed for the use of measuring instruments in 3D rheology when using them in rotational (P. Heyer, Ostfildern) or oscillatory modes (M. Schäffler, Ostfildern). Special features of rheo-optical methods were explained as the combination of rheometers with various optical sensors such as microscopy, small angle and wide angle light scattering, X-ray scattering and others (H. Schnablegger, Graz). Special emphasis was placed on innovative techniques and most of the functionalities were demonstrated on the basis of various practical applications.

The general aspects of interfacial science and the principles of 2D rheology comprising dilational and shear deformations of liquid surfaces and interfaces between immiscible liquids were introduced (R. Miller, Potsdam). The shear rheology (J. Krägel, Potsdam) and compression and expansion studies as the main second type of interfacial deformation (A. Makievski, Berlin) were presented in form of general overviews with specific details on the most modern experimental equipments.

While interfacial shear rheology represents a transient zone which can be accessed also by bulk rheometers when equipped with special measuring bodies, the dilational rheology of interfaces is unique. Due to the short history of interfacial mechanics, commercial instruments have been available for just a few years. Although the history began with techniques based on the damping of generated surface waves, most of these modern instruments for the measurement

Figure 1:
Participants of the 2D/3D rheology seminar in the hotel lobby.

© Appl. Rheol. 17 (2007) 164–165

This is an extract of the complete reprint-pdf, available at the Applied Rheology website
http://www.appliedrheology.org

of the dilational elasticity and viscosity utilise now the deformation of drops and bubbles.

Accurate 3D rheological methods proved to be very useful for the structural analysis of viscoelastic solutions. The shape and size effects of surfactant micelles (M. Gradzielski, Berlin) or the types of interaction between polymers and surfactants (J. Koetz, Potsdam), both leading to various kinds of liquid phases can be successfully studied by these techniques. Knowledge of the dilational and shear rheology of interfacial layers formed by surfactants (H. Motschmann, Potsdam) and proteins (J. Benjamins, Wageningen) was shown to be important for understanding the stabilisation or destabilisation of foams and emulsions. Rheological studies of complex fluids in food processing (J. Engmann, Lausanne) and in many other industrial technologies (M. Ranft, Ludwigshafen) turned out to be of great relevance for the control of productions stability as well as for the quality of the final products.

Contributions on the rheological behaviour of foams (A. Berthold, Berlin) and complex liquids (V. Dutschk, Dresden) demonstrated nicely how closely related bulk and interfacial rheology are. Fig. 2 illustrates that the rheological behaviour of liquid systems like emulsions of low disperse contents is essentially dominated by that of the matrix liquid.

When the part of the dispersed phase increases, as it is the case in concentrated emulsions or in foams, any bulk deformation of the material leads directly to deformations of the internal interfaces, i.e. local compressions and expansions but also shear. Hence the rheological bulk behaviour is directly linked to the interfacial response of the dispersed phase.

The test measurements on 3D rheology were performed with Physica MCR rheometers, demonstrating the high innovation standard of Anton Paar instruments. The 2D rheology practical tests were presented with the SINTERFACE interfacial torsion shear rheometer ISR 1 and drop/bubble profile analysis tensiometer PAT-1 suitable for low and higher frequency oscillation deformations of surface and interfacial layers.

Many participants expressed that they would join a future event of this type again, due to the high quality of presentations, the excellent meeting preparation by U. Lippke (Ostfildern) as seminar coordinator and by the team of the Ibis Hotel in BerlinAdlershof.

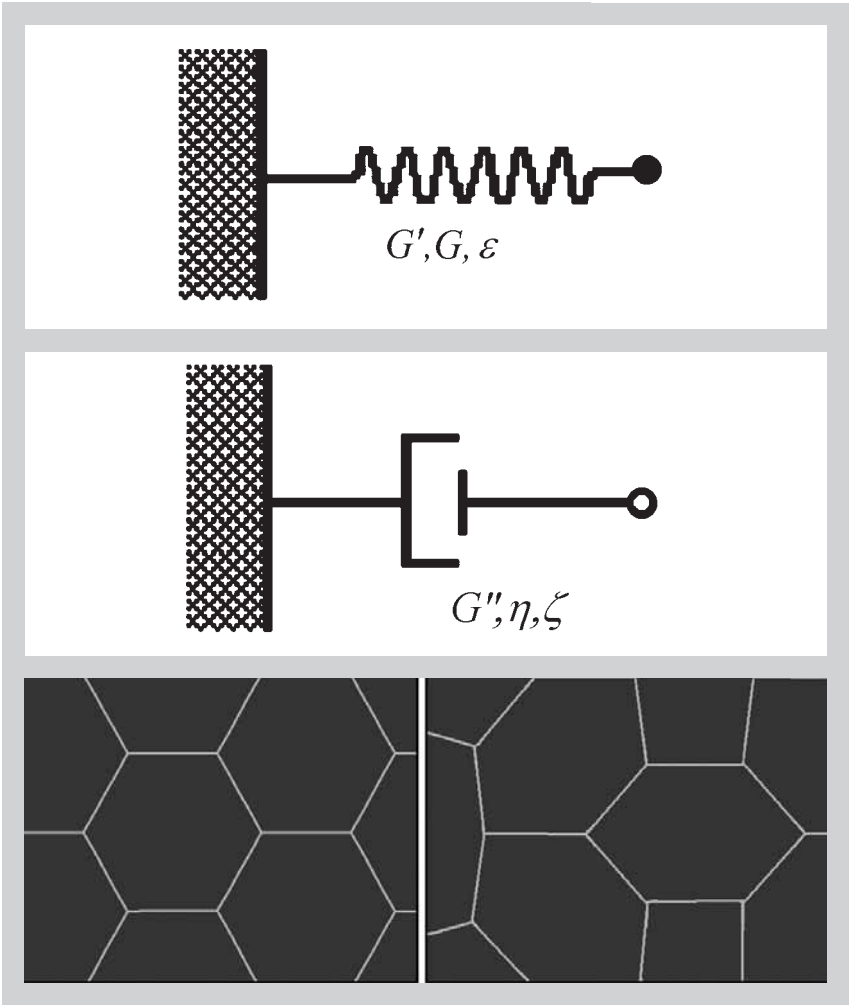

Figure 2 (above/middle): Spring and dashpot as symbols for elasticity and viscosity, used in 2D and 3D rheology and representing the main rheological quantities.

Figure 3: Schematic of a complex liquid at low and high disperse content at low and high shear flow.

The second seminar of this type is scheduled for May 2008 in Potsdam (details are available via www.sinterface.de/Anwenderseminar 2D-3D-Rheologie.html). In addition we plan a similar seminar for an international auditory in August 2008 in Berlin during the SIS2008, the 17th Surfactant in Solution Conference (http://sis2008.mpikg.mpg.de/).

M. Schäffler
Anton Paar Germany GmbH
Helmut-Hirth-Straße 6
73650 Ostfildern
info.de@anton-paar.com

R. Miller
SINTERFACE Technologies
Volmerstraße 5-7
12489 Berlin
info@sinterface.com

This is an extract of the complete reprint-pdf, available at the Applied Rheology website
http://www.appliedrheology.org