

The EUROMECH Colloquium 487 “Structure Sensitive Mechanics of Polymer Materials: Physical and Mechanical Aspects”

STRASBOURG, FRANCE
OCTOBER 10 – 13, 2006



The EUROMECH Colloquium 487 has been held in Strasbourg on October 10-13, 2006. It was organized by the Institute of Mechanics of Fluids and Solids ULP-CNRS (France) in cooperation with the Semenov Institute of Chemical Physics of the Russian Academy of Sciences (Russia). This is the

second meeting on the subject of “Structure Sensitive Mechanics of Polymer Materials”. The first one took place in Moscow on January 2004 as the International Symposium in the framework of the 3rd Kargin Conference “Polymers-2004”.

The topic of the Colloquium was defined by the modern state of polymer mechanics demanding accounting the coupling between mechanical behavior and structural evolution of deforming solid polymers. In spite of a long term history, a large piece of these problems is still obscure. Their interdisciplinary character appeals for common efforts of both mechanical and physical communities. In this context, the meeting aimed to stimulate discussions and enhance

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deformations of various classes of polymer solids as crystals, glasses, and thermotropic LC rigid polyesters. Analyzing the energy stored during plastic deformation of the each polymer group, the author has revealed the liquid-like and the solid-like mechanisms governing plastic flow. Structural and kinetic origins of these mechanisms were discussed. This picture was amplified by experimental observations specified in the plenary lecture of Prof. M. Matsuo (Nara, Japan) who presented a manifold information on relaxation processes of polyethylene films and fibers with different degrees of molecular orientation and crystallinity measured by the dynamic mechanical relaxation, positron annihilation and ^{13}C NMR.

The essential problems of mechanics and physics of reinforced rubbers were elucidated in three plenary lectures of Prof. G. Heinrich (Dresden, Germany), Dr. M. Klüppel (Hanover, Germany), and Prof. T. Vilgis (Mainz, Germany). The first speaker has acquainted participants of the EUROMECH Colloquium on the research collaboration funded by the German Research Foundation between five physical and engineering institutes intending to gain a multi-scale understanding of the fracture process in the reinforced elastomeric blends. He provided an example of new methodology, based on the energetical characterisation and the configurational force approach, which is able to reveal an influence of intrinsic material parameters on the crack propagation. Dr. M. Klüppel presented comprehensive review on structure sensitive behavior of the reinforced rubbers based on the advanced concept of rubber elasticity together with a micro-mechanical model of stress-induced breakdown of filler clusters. The lecture focused on evaluation of stress softening and filler induced hysteresis along with description of their temperature dependences. Prof. T. Vilgis has underlined that reinforced materials represent a typical example for multi-scale physical problems. In his lecture, the theoretical aspects of the bound rubber phase in filled rubbers were discussed. The main accent was put on static and dynamic properties of chains localized at the heterogeneous surfaces.

Micromechanical effects of plastic yielding in macroscopically brittle amorphous polymers were presented in the plenary lecture of Prof. G.H. Michler (Halle, Germany). Using various micro-

scopic methods, including scanning electron, transmission electron and atomic force microscopy, he demonstrated many examples of structurally modified polymers where the usually brittle polymer can be deformed to a high degree, yielding an enhanced toughness. Dr. M.A. Khaleel (Richland, USA) has combined an important scientific content on experiments and modeling of laminated nano-reinforced polymers along with the technological innovations in fabrication and optimization of automotive side windows. Morphology, mechanical, and physical properties of polymer-based composites were also discussed also in the oral communications of Prof. D. Baptiste et al. (Paris, France), Dr. M. Saphiannikova et al. (Dresden, Germany), Prof. A. Svistkov et al. (Perm, Russia), Dr. S. Timan and Dr. M. Shamaev (Moscow, Russia), Dr. J.-M. Vacherand (Clermont-Ferrand, France).

Local and global mechanical properties (modeling and experiment) of polymeric foams as multi-scale cellular materials were reported in the oral communication of Dr. I. Iordanoff and Mr. R. Bouix et al. (Talence, France). In the talk of Prof. Berlin (Moscow, Russia) there was highlighted that this kind of structures may be characterized by the negative Poisson ratio due to the cell buckling.

In the plenary lecture of Prof. L.E. Govaert (Eindhoven, Netherlands) the interesting results on 3D modelling enabling a quantitative analysis of localization followed by a short and a long-term failure were presented. Taking into account deformation and physical ageing kinetics, the speaker has shown simulation data for polycarbonate in static and dynamic loading. The physically based constitutive equation describing localization and strain hardening phenomena was considered in the oral communication of Dr. Rinaldi et al. (Villeurbanne, France). In the plenary lecture of Prof. J.-M. Haudin (Sofia Antipolis, France), the substantial review on modelling of structure development of semicrystalline polymers during processing has been delivered. He informed on development of a general model allowing prediction of different morphological parameter under complex conditions encountered in polymer processing or injection moulding.

Physical aging and structural recovery of temperature-glasses and concentration glasses has been presented in the plenary lecture of Prof.

G. McKenna. He reported that the glass created by jumping to a given final condition via a change in concentration is more stable than that formed by a change in temperature. In other words, the physical aging occurs more slowly and the structural recovery takes place over much longer times. The author has suggested that the two routes to glass formation result in different inherent structures. Mechanical properties of glassy amorphous polymers were also analyzed on molecular-scale level in the oral presentations of Prof. J.-L. Halary (Paris, France) and Dr. C.P. Buckley (Oxford, UK). The role of chain mobility and the molecular structure were underlined in these talks, respectively.


Unfortunately we could not illuminate all contributions in this short report. Generally, the informal discussions conducted in the Colloquium were very stimulating and fruitful. They reflected a common interest to the objectives and selected problems considered at the meeting. The full-scale papers presented at the EUROMECH Colloquium 487 will be published (based on the regular journal review procedure) in the special issue of Polymer Science A.

In the closing ceremony, Prof. S. Ahzi has announced the next meeting on the "Structure Sensitive Mechanics of Polymer Materials" which is going to be held in Marrakech (Morocco) in 2008.



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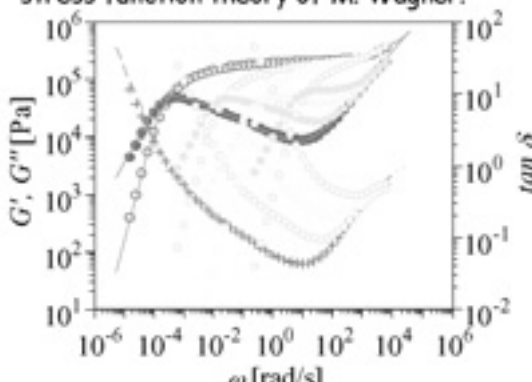
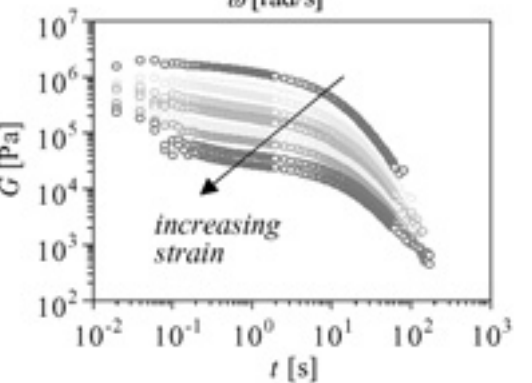
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IRIS (new) predicts from molecular theory: (a) tube dilation theory of T. McLeish and coworkers and (b) molecular stress function theory of M. Wagner.

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