# Structure and properties of polymer networks

9th Europhysics Conference on Macromolecular Physics

Jabłonna, Poland, 23–28 April, 1979

*Organized by the Macromolecular Physics Board, the European Physical Society and the Network Group, affiliated to IUPAC*

The idea of the Organizer was to bring into short-range interaction (with or without collision) scientists from various backgrounds, with different research philosophies, all working in the field of polymer networks; the Conference certainly lived up to expectations. Among the 143 participants from 29 countries, the majority were polymer physicists and chemists. Also present (and active) were theoretical physicists, mathematicians, and mechanical and chemical engineers from universities and industry.

The scientific programme included 15 invited lectures delivered by authors selected by the International Advisory Committee. In addition, 70 contributed papers on the following six topics were accepted for poster sessions:

(i) network structure and its relation to crosslinking processes;
(ii) theory of rubber elasticity (statistical and phenomenological);
(iii) entanglement of polymer chains and the behaviour of entangled systems;
(iv) physical properties of polymer networks;
(v) crystallization of crosslinked polymers;
(vi) thermally reversible networks (gels) and biological networks.

Abstracts of all the papers (invited and contributed) had been preprinted and were distributed during the Conference. The programme was completed by seven Topic Discussions, prepared and conducted by specially appointed Discussion Leaders.

Among the invited lectures which appear in this Edition, three concern the formation of network structure [topic (i)]. **Stepto** discusses a kinetic theory and crosslinking experiments followed by studies of the physical properties of the resulting networks. **Ziabicki** proposes a formal, phenomenological description of network topology based on junction distribution functions, and derives these functions and the related macroscopic properties for a random tetrafunctional system. **Elyashevich** discusses the possibility of a computer simulation of network formation and the related mechanical behaviour, including ultimate strength and stress relaxation. Formation of networks is also discussed in the lecture by **Kästner**, concerned with the changes in relaxational properties accompanying crosslinking.

The theory of rubber elasticity [topic (ii)] was given in three lectures, two statistical and one phenomenological. **Flory** presents an extension of the classical 'phantom' theory, using a more recent concept of constrained junction motions. **Ball and Edwards** elaborate on a statistical–thermodynamic theory of deformation of dilute networks. **Tschoegl** presents a non-linear constitutive equation of rubber elasticity which, unlike many earlier models, seems to be invariant with the geometry of deformation. The experiments reviewed in the paper support the model surprisingly well.

The concept of chain entanglement seems still to be the centre of interest for many researchers, and raises both positive and negative feelings. Three lectures are concerned with this problem. **Kramer** reviews the contribution of entanglements to the elasticity of polymers. **Ferry** describes in more detail his own direct approach – fixing the 'temporary entanglement network' by chemical crosslinks and then applying 'the two-network' theory to the determination of the fraction of entanglements entrapped between permanent crosslinks. Sceptical **Gordon**, on the other hand, applies **Occam's Razor** to entanglements interpreted mechanistically, and proposes an alternative approach – a 'graph-like state of the matter'.

In topic (iv) (Physical Properties), two lectures deal with the relaxational behaviour of polymer networks. **Ronca** presents a molecular theory for the long-time dynamics of networks, while **Kästner** analyses theoretically and experimentally the mechanical and dielectric relaxation of polymers in various stages of network formation from monomers or oligomers. The mechanical properties of thermoplastic elastomers are discussed by **Bonart**, and neutron scattering in model networks and uncrosslinked polymers is analysed by **Picot**. These, and other physical properties were also presented in numerous posters.

The crystallization of crosslinked polymers [topic (v)] was also represented by many contributed papers. The lecture by **Keller** reports a thorough structural analysis of crystallization in stressed gels, the process evidently yielding different lattice structures and morphologies to those observed in the same polymer precipitated from a solution or crystallized from the quiescent melt.

Last, but not least, topic (vi) (Gels and Biological Networks) was represented by the lecture by **Tanaka** who studied critical phenomena and phase transitions in polyacrylamide gels. Several contributed papers were concerned with theories and experiments related to gelatin and other hydrophilic gels.

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The Organizer wishes to thank the *International Advisory Committee*

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Thanks are also due to members of the National Organizing Committee, with special reference to its secretary, Dr Andrzej Wasiak, whose efforts greatly contributed to the organization of the Conference. Last but not least, the Organizer would like to thank the Invited Speakers, Discussion Leaders and Authors of Papers, whose contributions were greatly appreciated by the Organizer and all those present.

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The Conference volume is available from the European Physical Society, Petit Lancy, Switzerland, *title*: Europhysics Conference Abstracts, Volume 3C, 'Structure and Properties of Polymer Networks'.

The manuscript from Professor Picot is currently unavailable and an abstract only is reproduced in this volume.