Selected Topics of Polymer Science

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In 8 lectures special questions in polymer science are discussed. The consideration starts with well known elementary facts, but soon leads to demanding questions. This demand results from the somewhat deviating view of a preparative chemist from that of a physicist whose intention is to find an explanation of the properties of the prepared materials. Difficulties in digesting these aspects will arise. Therefore, the audience should be encouraged to interrupt the presentation and ask for a repeat of the outline whenever it appears appropriate. A free discussion will be beneficial to both sides. The following gives a short summary of the topics in the eight lectures.

MONDAY, 4 March, 11.00-13.00

The ***first lecture*** will be concerned with the questions of a controlled reaction. The principles behind this concept can be cast into a fundamental theory. A new algorithm is introduced and will be explained at detail with the simple example of coupled linear chains. This new algorithm can easily be expanded towards branched samples, which will be the topic of the last two lectures.

The ***second lecture*** will deal with methods of polymer characterization and with a discussion which parameters can be measured without using presumed yet not proven models. Molar mass determination, measurement of intrinsic viscosity etc. Furthermore the techniques of size exclusion chromatography (SEC) and of field flow fractionation (FFF) in combination with viscosity and light scattering detectors are briefly described.

TUESDAY, 5 March, 10.00-12.00

In a ***third lecture*** the method of light scattering from small macromolecules is outlined, avoiding complex mathematical derivations as much as possible. Small means particles with an apparent radius $R_{app} < \lambda/10$ where λ is the wavelength of monochromatic visible light. The decisive occurrence of density and concentration fluctuations is emphasized, since from these fluctuations information on the inter-particle interaction can be obtained. These results from thermodynamics are compared with those from the intrinsic viscosity.

The ***fourth lecture*** comprises a continuation of the light scattering phenomena from large macromolecules and the occurrence of an angular dependent scattering intensity. This angular dependence is characteristically influenced by the shape of the particles, but also permits insight into the segmental structure of the macromolecule. Furthermore, the concentration dependence of this angular dependence of scattered light is considered.

WEDNESDAY, 6 March, 10.00-12.00

In the ***fifth lecture*** the basics of dynamic light scattering are outlined. It will be shown that besides the diffusion coefficient and the resulting hydrodynamic radius R_h the segmental motion can be recorded. The effect of excluded volume and fractal behavior are discussed. An overview over the four radii, obtained from static and dynamic light scattering, the intrinsic viscosity and from the inter-particle interactions is given combined with a tentative interpretation.

The ***sixth lecture*** gives an overview over branched architectures. Results from specially synthesized models are presented. Attempts of interpretation of these structures lead to the need of a more reliable support by theoretical developments.

THUERSDAY, 7 March, 10.00-12.00

The ***last two lectures*** are devoted to the outline of the branching theory in comparison to the experimental findings. This theory is an extension of the scheme discussed already in the first lecture. The theory is simple and requires no more than school mathematics. However, the new algorithm may cause mental difficulties, since the mathematics appear in an artificial space in which a complex looking correlation in the Euclid space are converted into simple algebraic relationships. Return to the common Euclid space is possible at any stage. Much time for discussion will be left.