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Molecular characterization of block copolymers by liquid chromatography

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Block copolymers represent an important group of materials with extensive applications in science, medicine and technology. In the block copolymer, two-, three- or even several chemically distinct polymer chains are mutually connected with a chemical bond, whereas the length and polarity of particular blocks can differ remarkably. Molecular characterization of block copolymers involves determination of chemical composition of particular blocks, their molar mass, both averages and distributions, as well as presence and amount of parent homopolymers. Determination of molar mass of block copolymers and assessment of parent homopolymers, represent an analytical challenge. Most synthesists employ gel permeation chromatography, GPC (size exclusion chromatography) for determination of molar mass of precursors, as well as for a rather rough assessment of total molar mass of block copolymers. However, GPC produces only molar mass estimates of block copolymers because size of their macromolecules in solution depends on properties of both kinds of chains. Special problem is determination of amount and characteristics of parent homopolymers, which are present in most block copolymers, and which constitute highly undesired, expensive ballast. Due to low separation selectivity and detector sensitivity of GPC, parent homopolymers usually cannot be efficiently separated from the block copolymers to even trace their presence. We will discuss principles and applications the alternative liquid chromatography methods for comprehensive molecular characterization of block copolymers, namely liquid chromatography under critical conditions, LC CC, liquid chromatography under limiting conditions of enthalpic interactions, LC LC and sequential two-dimensional polymer liquid chromatography, S2D-LC. LC CC is rather frequently used for separation of one parent homopolymer from a block copolymer and for estimation of molar mass of blocks created in the second stage of synthesis. However, LC CC exhibits numerous drawbacks such as low experimental robustness and therefore limited repeatability of measurements, restricted sample both recovery and capacity, as well as extensive band broadening. LC LC is rather robust and experimentally feasible. Its separation selectivity is very high and sample recovery is reasonable. LC LC can easily and efficiently discriminate both parent homopolymers from diblock copolymers. The base-line separated peaks of all sample constituents obtained with help of LC LC can be one-by-one on-line forwarded into the GPC column for molar mass average and distribution determination. Parent homopolymers present in the block copolymer at very low concentrations below 1% of can be traced and characterized, by this new approach, called S2D-LC.

Biography

Dusan Berek works at the Polymer Institute, Slovak Academy of Sciences in Bratislava. He has served as the Elected Member of the Presidium of the Slovak Academy of Sciences, President of the Slovak Chemical Society, Chairman of the Czecho-Slovak and Slovak National Committee of Chemistry for IUPAC. He is a corresponding member of the Central European Academy of Sciences and member of the Learned Society of the Slovak Academy of Sciences. He has author two monographs and more than 300 scientific papers in reputed journals, proceedings and book chapters. He has more than 60 patents. He has presented over 120 invited plenary, key and main lectures, as well as over 900 regular lectures and poster contributions on symposia and conferences.

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