TWO-DIMENSIONAL LIQUID CHROMATOGRAPHY OF COMPLEX POLYMERS: PDMS-PS BLOCK COPOLYMERS

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ABSTRACT

Polymers are complex materials with distributions in many properties. These distributions include molar mass distribution, chemical composition distribution, functionality type distribution etc. amongst others. Naturally, these distributions can have enormous effects on the final properties of the materials. The development of reliable and fast characterization methods for such complex polymeric systems is one of the challenges for polymer scientists and technologists. Better and faster characterization methods lead to better and faster screening of products and helps enormously in developing improved synthesis procedures. A single technique is not sufficient for the comprehensive analysis of such complex polymers since SEC provides only relative MMD irrespective of chemical composition and the spectroscopic techniques like NMR, FTIR etc. provide only average chemical composition without any information of molar masses. Furthermore, it is more time consuming to do an analysis of two different properties by two independent runs. In addition, it has been shown previously that important information can be missed during the analysis of block copolymers if each single technique is used independently. In principle one needs N number of techniques or dimensions for the analysis of N number of properties. There must be a hyphenation of these techniques or there must be modes of characterization which are capable of analyzing the products according to a single property, ideally without or at least with only minimal effects of the other distributions.

In this study, PDMS-PS block copolymers are characterized by two-dimensional liquid chromatography. Comprehensive two dimensional liquid chromatography using LCCC as first dimension and size exclusion chromatography as second dimension reveals very important information about composition and molar masses of different fractions which were not possible by using both techniques independently.

Furthermore, by an offline approach; fractions are collected from first dimension and subjected to analysis in the second dimension. Block copolymer fractions are subjected to LCCC of the other block in the second dimension to see if there is any homopolymer of second block present in the sample. Fractions from LCCC are also analyzed qualitatively as well as quantitatively by FTIR. Different collection modes of FTIR namely ATR, transmission, reflectance and transmission in solution are compared for qualitative as well as quantitative analysis of fractions and raw samples.