FIELD-FLOW FRACTIONATION: AN ALTERNATIVE ANALYTICAL TECHNIQUE FOR FLEXIBLE CHARACTERIZATION OF POLYMERS AND NANO-PARTICLES WITH HIGH RESOLUTION

Tino Otte[1,*] Thorsten Klein[1]

[1] Postnova Analytics, Max-Planck-Str. 14, 86899 Landsberg (Germany)
tino.otte@postnova.com, www.postnova.com

ABSTRACT

So far, the analysis of nano-particulate structures or polymers with increased branching, cross-linking or ultrahigh molar mass content was extremely laborious or sometimes impossible. Different instruments were necessary to fully characterize such materials due to the huge variability in size, chemical composition and structure of the samples. In recent days the long-time known principle of Field-Flow Fractionation (FFF)[1-2] has experienced a revival. The technique enables to separate different materials without the negative effects caused by a stationary phase or column packing[3-5]. The separation is achieved in a narrow ribbon-like channel. An external separation force interacts with the analyte and leads to the separation of the components according to different parameters[6]. As a consequence various solvents can easily be used without time consuming equilibration steps or costly column exchange. Moreover, there is practically no limitation in the upper size of the analyte species since a size separation reaching from a few nano up to several hundred micrometers is possible.[7-8] At the moment four different FFF sub-techniques are commercially available: Asymmetrical Flow FFF (AF4) for separation according to hydrodynamic size, Thermal FFF (TF3) for separation according to size and chemical composition and Centrifugal FFF (CF3/SdF3, also called Sedimentation FFF) which provides separation according to size and density. The gravitational SPLITT FFF is a preparative FFF system which enables to separate particles continuously into two size fractions.

In this presentation the potential of FFF is shown on the example of different characterization problems. The individual FFF separation principles will be introduced briefly and the quality of the analysis is verified with standards and reference material. In addition some unique advantages of the Flow FFF, which is the the most universal FFF type, are discussed.

Polymers and nano-particles which are difficult to analyze with alternative methods are characterized using the different FFF methods with the aim to point out the strengths of the different FFF variants. Finally the results are compared with traditional methods, with the aim to show the supplementary information which is only accessible by FFF.

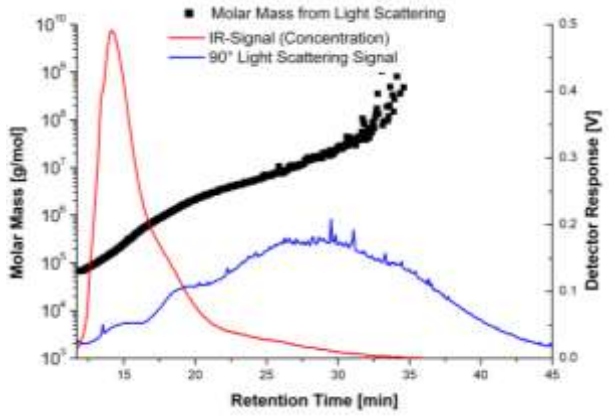

Fig. 1: *Separation of high molar mass PE with HT-AF4*

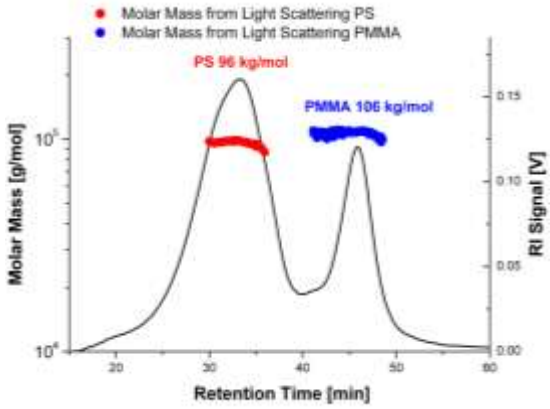

Fig. 2: *TF3-separation of PS and PMMA with virtually the same hydrodynamic volume*

References

(1) Giddings, J. C. *Sep. Sci.* **1966**, *1*, 123-125.
(2) Caldwell, K. D.; Kesner, L. F.; Myers, M. N.; Giddings, J. C. *Science* **1972**, *176*, 296-298.
(3) Parth, M.; Aust, N.; Lederer, K. *Int. J. Polym. Anal. Charact.* **2003**, *8*, 175-186.
(4) Aust N. *J. Biochem. Biophys. Meth.* **2003**, *6*, 323-334.
(5) Otte, T.; Brüll, R.; Macko, T.; Pasch, H. *J. Chrom. A* **2010**, *1217*, 722-730.
(6) Schimpf, M. E.; Caldwell, K. D.; Giddings, J. C. *Field-Flow Fractionation Handbook, Wiley & Sons* **2000**, New York.
(7) Messaud, F. A.; Sanderson, R. D.; Runyon, J. R.; Otte, T. *Prog. Polym. Sci.* **2009**, *34*, 351-368.
(8) Williams, S. K. R.; Lee, D. *J. Sep. Sci.* **2006**, *29*, 1720-1232.