Application Brief

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GPC/SEC Analysis of Poly(2-vinylpyridine)s

Author

Mathias Glaßner
Agilent Technologies, Inc.

Abstract

This application brief illustrates the GPC/SEC analysis of poly(2-vinylpyridine)s (PVP) in an acidic aqueous eluent using a set of Agilent NOVEMA Max columns as stationary phase.

Introduction

PVP is prepared by polymerization of 2-vinylpyridine. PVPs are weak bases. In acidic solvents or after quaternization, they become water-soluble polyelectrolytes. PVPs are used as ion exchangers, flotation additives, or for the preparation of polymer-supported catalysts. Due to the cationic nature of their surface under acidic conditions, NOVEMA Max columns are ideal for GPC/SEC analysis of cationic macromolecules in aqueous eluents, having a pH in the range of 1.5 to 7.0.[1]

Experimental

Table 1. Instrument and sample conditions.

	Conditions
Pump	Isocratic pump Flow rate: 0.5 mL/min Mobile phase: H_2O, 0.1 M sodium chloride, 0.3 vol% formic acid
Injection System	Autosampler Injection volume: 20 µL
Columns	NOVEMA Max ultrahigh MW combination: NOVEMA Max 10 µm precolumn, 8 × 50 mm (p/n NMA080510) 3 × NOVEMA Max 10 µm ultrahigh, 8 × 300 mm (p/n NMA083010LUH)
Temperature	23 °C
Sample Concentration	1 mg/mL (0.5 mg/mL for samples > 1,000,000 Da)
Calibration	Agilent calibration kit poly(2-vinylpyridine) (p/n PSS-PVPKIT)
Detectors	Variable wavelength UV-Vis detector (VWD) at λ = 254 nm Refractive index (RI) detector
Software	Agilent WinGPC

Results and discussion

Robust and reliable GPC/SEC analysis of poly(2-vinylpyridine)s was performed using a set of NOVEMA Max columns as stationary phase and aqueous 0.1 M sodium chloride solution with 0.3 vol% formic acid as mobile phase, ensuring the cationic nature and solubility of the samples. The NOVEMA Max ultrahigh MW combination, composed of one NOVEMA Max 10 µm guard column together with three NOVEMA Max 10 µm ultrahigh columns, has a wide separation range with good resolution from low up to ultrahigh molar masses.

Figure 1 shows the chromatograms of 7 PVPs ranging from Mp = 620 to 1,160,000 Da.

Calibration with poly(2-vinylpyridine) standards allows the analysis of absolute molar masses. The corresponding molar mass distributions (MWD) are shown in Figure 2.

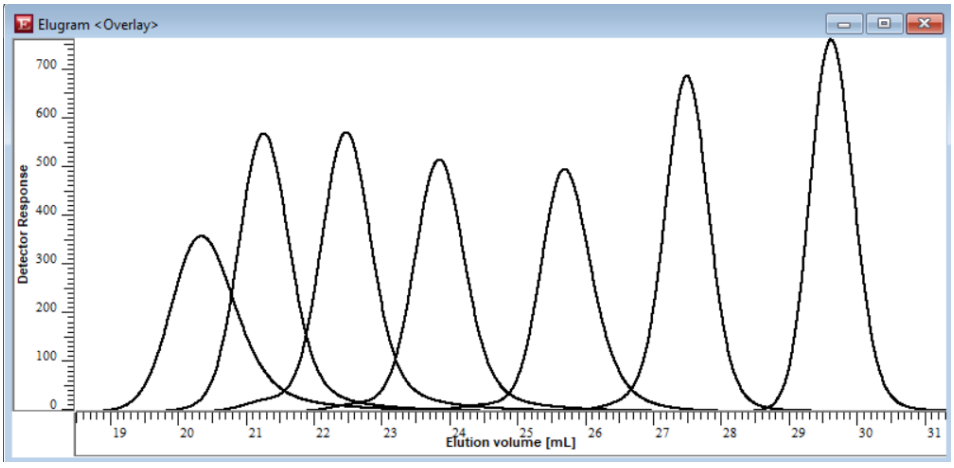

Figure 1. Overlay of UV at 254 nm traces for seven different PVP samples.

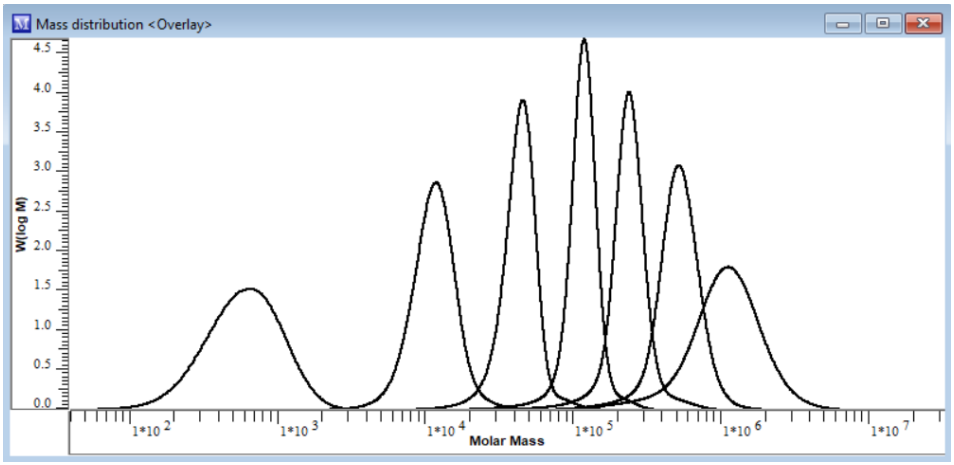

Figure 2. Comparison of the molar mass distributions (based on calibration with poly(2-vinylpyridine) calibration kit).

Conclusion

Agilent NOVEMA Max columns can resolve molar mass distributions of PVPs by GPC/SEC analysis. The cationic surface enables interaction-free GPC/SEC analysis of cationic polymers using a suitable aqueous eluent.

Reference

1. Mavronasou, K. *et al.* Poly(vinyl pyridine) and Its Quaternized Derivatives: Understanding Their Solvation and Solid State Properties. *Polymers* **2022**, *14*, 804.

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