LAAN-A-LC-E194

SHIMADZU

Application News

High Performance Liquid Chromatography No.L416

Analysis of Hexafluorophosphate Ion in Electrolytic Solution for Lithium-Ion Rechargeable Batteries by Ion Chromatography

Lithium hexafluorophosphate is a common electrolyte used in rechargeable batteries. Here, we introduce an example of the analysis of hexafluorophosphate ion in the electrolytic solution of a lithium-ion rechargeable battery with the Shimadzu Prominence HIC-SP suppressor-type ion chromatograph.

■ Analysis of Standard Solution

Fig. 1 shows the chromatogram obtained from analysis of a hexafluorophosphate ion standard solution, and Table 1 shows the analytical conditions.
Due to the extremely strong retention of the hexafluorophosphate ion on the Shim-pack IC-SA2 column which is the standard column for the Prominence HIC-SP, the Shim-pack IC-SA2(G) guard column was also used. Moreover, instead of using the difficult to handle lithium hexafluorophosphate as the standard solution, ion analysis was conducted using potassium hexafluorophosphate instead.

Table 1 Analytical Conditions

Column	: Shim-pack IC-SA2(G) (10 mm L. × 4.6 mm I.D.)
Mobile Phase	: 12 mmol/L $NaHCO_3$, 0.6 mmol/L Na_2CO_3
Flow Rate	: 1.0 mL/min
Injection Vol.	: 10 µL
Column Temp.	: 30 °C
Detection	: CDD-10A$_{SP}$ (Suppressor)

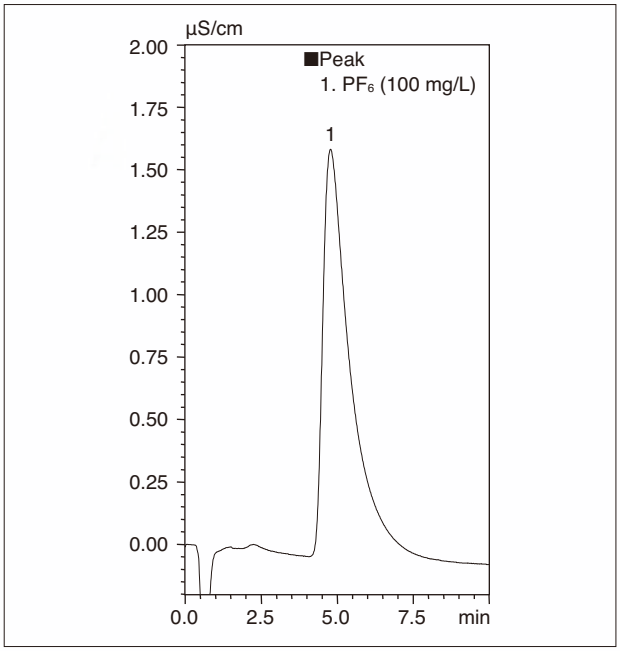

Fig. 1 Chromatogram of Hexafluorophosphate Ion

■ Linearity

Fig. 2 shows the calibration curve generated using hexafluorophosphate ion standard solutions with concentrations from 2.5 to 250 mg/L. Excellent linearity was obtained with an R^2 value greater than 0.999.

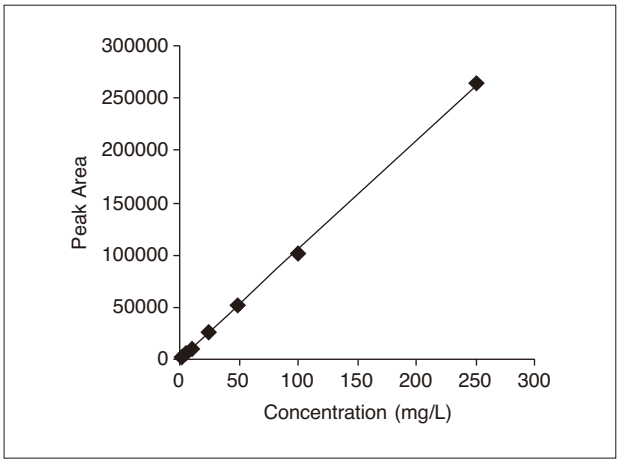

Fig. 2 Linearity

■ Repeatability

Table 2 shows the retention time and peak area relative standard deviation (n = 6) obtained from analysis of a 100 mg/L standard solution. Excellent repeatability of both retention time and peak area were obtained.

Table 2 Repeatability of Retention Time and Peak Area

	Retention Time	Peak Area
1st	4.78	102135
2nd	4.78	102422
3rd	4.79	100941
4th	4.77	103548
5th	4.77	101649
6th	4.77	102475
%RSD	0.16	0.86

■ Analysis of Electrolytic Solution for Lithium-Ion Rechargeable Battery

Fig. 3 shows the chromatogram obtained from the analysis of an electrolytic solution in a commercially available lithium-ion rechargeable battery. The electrolytic solution was analyzed after diluting it 1000 to 1 with pure water, and then filtering it through a membrane filter.
Table 3 shows the quantitation result. The concentration of this particular lithium ion rechargeable battery electrolytic solution was reported to be 1 mol/L, and the actual value obtained using the above-mentioned analytical conditions was 1.00 mol/L (144.6 mg/L). Lithium hexafluorophosphate is hydrolyzable, but good quantitation results were obtained under these conditions.

Table 3 Quantitative Value

	Displayed Rating Value	Analytical Value
$LiPF_6$ Concentration	1 mol/L	1.00 mol/L

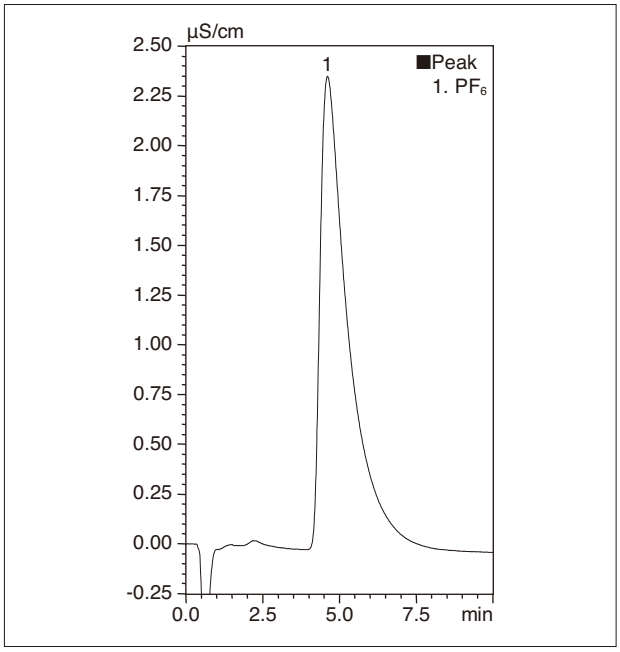

Fig. 3 Chromatogram of Electrolytic Solution for a Lithium-Ion Rechargeable Battery

[Referenc]
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