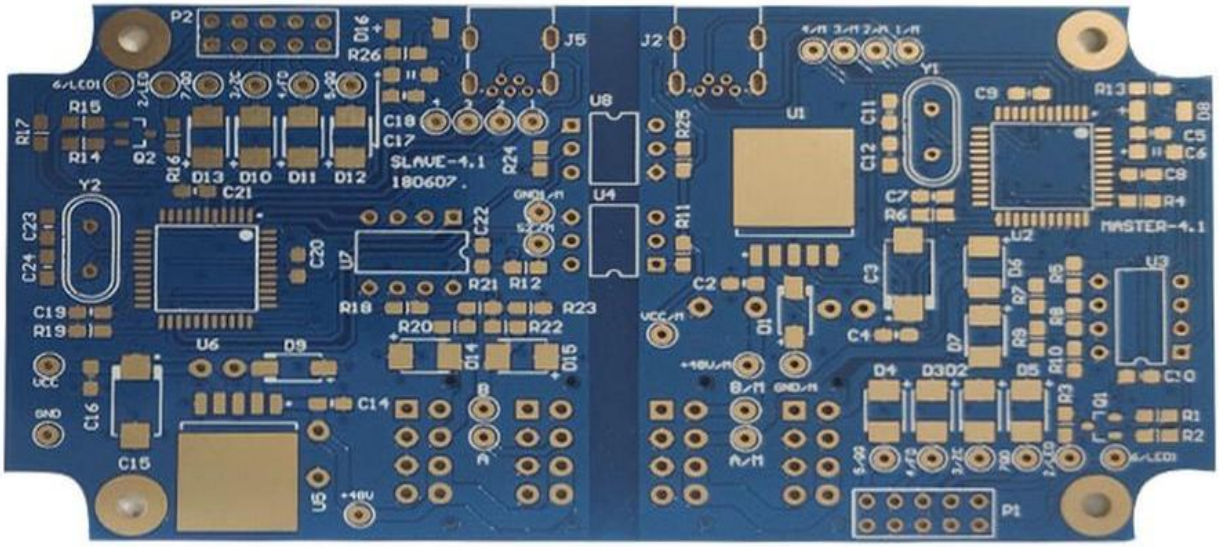

Detection of multiple ions in circuit board

Introduction:

The density of the electrical components on the PCB circuit board is high, and the residual separation on the surface will cause the possibility of separation migration, resulting in open circuit, short circuit and other phenomena. If there is acid residue on the surface of the circuit board, it will corrode the circuit board and reduce the service life of the product.

Detection items (Table 1):

Anion	F^-	Cl^-	NO_2^-	Br^-	NO_3^-	SO_4^{2-}	PO_4^{3-}
Cation	Li^+	Na^+	NH_4^+	K^+	Mg^{2+}	Ca^{2+}	
Organic acid	Acetic acid	Formic acid	Methane sulfonic acid	Malic acid	Succinic acid	Adipic acid	Phthalic acid

Keywords: PCB, circuit board, Ion chromatography

Instruments and equipment

- **Ion chromatograph**: CIC-D180
- **Ultra pure water machine**:ECO-S15

Qingdao Shenghan Chromatograph Technology Co., Ltd

Requirements

Reagents

All reagents used are superior grade pure or better,Purchase certified standard solutions F^-, Cl^-, NO_2^-, Br^-, NO_3^-, SO_4^{2-}, PO_4^{3-}, Li^+, Na^+, NH_4^+, K^+, Mg^{2+}, Ca^{2+}, acetic acid, formic acid, methanesulfonic acid, malic acid, succinic acid, adipic acid, phthalic acid,standard solutions (1000 mg / L).

Deionized Water

When preparing standard samples manually or diluting real samples, please use ASTM filtration and deionization requirements that meet the specifications listed in the table 2.

Table 2: Deionized water specification.

Specification	
Ions Resistivity	≥18.25MΩ·cm
Organics-TOC	<10ppb
Iron/Transition Metals	<1ppb
Pyrogens	<0.03Eu/mL
Particulates（>0.2μm）	<1unit/mL
Colloids-Silica	<10ppb
Bacteria	<1cfu/mL

Sample preparation

(1) Put the circuit board into a PE self sealing bag, add 640 ml of isopropanol water mixed solution (the volume ratio of isopropanol to water is 75:25), remove the gas, make the extraction solution fully contact with the circuit board, and take a water bath at 80 ℃ for 1 h.

(2) Pour out the leaching solution into a triangular flask and place it in a 90 ℃ water bath for 2 hours, so that isopropanol volatilizes and overflows. The remaining liquid is naturally cooled to room temperature, transferred to a 250 ml volumetric flask for constant volume, and passed through 0.22 μ M filter membrane injection analysis.

(3) Treat the mixed solution of isopropanol and water of the same volume according to the above steps as the solvent blank of the PE self sealing bag.

Standard chromatogram (Anion)

Standard chromatogram,As shown in below:

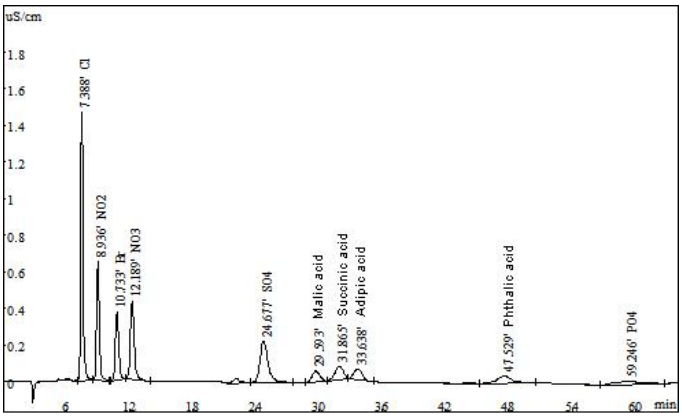

Figure 1. Chromatogram of anion standard sample.

Table 4: Data of anion standard solution

No.	Reten.time	Name	Concentration	Area	Peak height
1	7.388	Cl^-	1	18568621	1464610
2	8.936	NO_2^-	1	9875120	649078
3	10.733	Br^-	1	7231764	368324
4	12.189	NO_3^-	1	9856235	426541
5	24.677	SO_4^{2-}	1	11953115	229956
6	29.593	Malic acid	1	3054093	59917
7	31.865	Succinic acid	1	3635839	71354
8	33.638	Adipic acid	1	3066828	57106
9	47.529	Phthalic acid	1	4790150	45422
10	59.246	PO_4^{3-}	1	2639442	15676

Comparison testing (Anion blank)

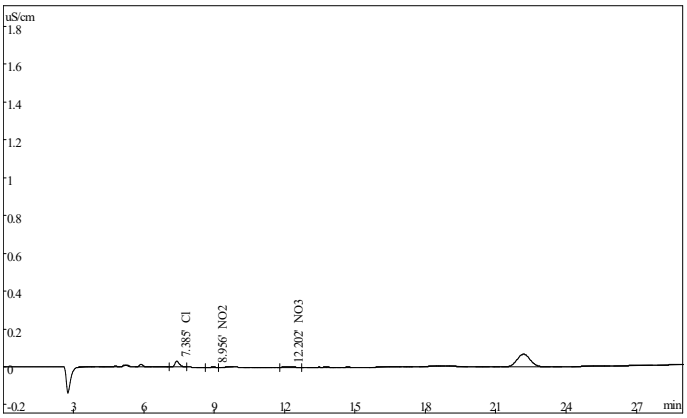

Figure 2. Chromatogram of Anion blank.

Table 5: Data of anion blank

Chromatographic conditions (Table 3):

	Column	Eluent	Flow rate	Column temperature	Injection volume	Suppressor current
Anion	SH-AC-11	10 mM KOH	1.0 mL/min	55℃	25 μL	60 mA
Cation	SH-CC-3L	5.5 mM MSA	1.0 mL/min	35℃	25 μL	45 mA
Organic acid	SH-AC-23	13 mM KOH	1.0 mL/min	35℃	25 μL	60 mA

No.	Reten.time	Name	Concentration	Area	Peak height
1	7.385	Cl^-	0.02769	514247	34878
2	8.956	NO_2^-	0.004241	41876	3123
3	12.202	NO_3^-	0.01434	141377	6315

Sample chromatogram (Anion)

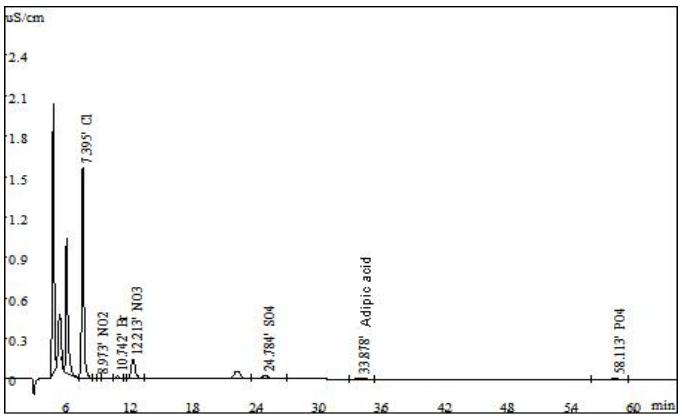

Figure 3. Chromatogram of anion in sample

Standard chromatogram (Cation)

Standard chromatogram,As shown in below:

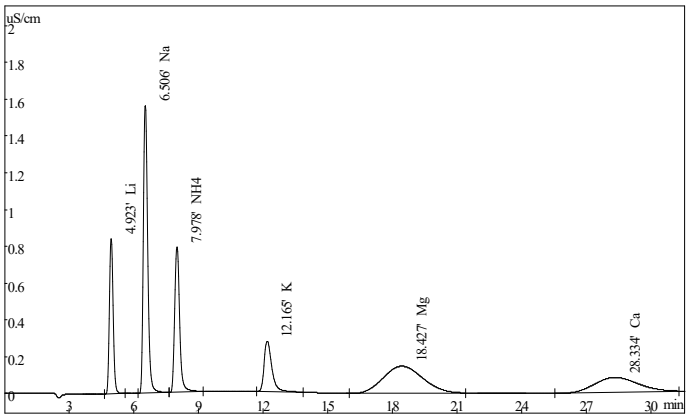

Figure 4. Chromatogram of cation standard sample.

Table 6: Data of cation standard solution

No.	Reten.time	Name	Concentration	Area	Peak height
1	4.923	Li^+	0.1	9511119	843894
2	6.506	Na^+	1	20511784	1566395
3	7.978	NH_4^+	0.5	11945453	789479
4	12.165	K^+	0.5	6492749	272982
5	18.427	Mg^{2+}	0.5	18784915	147791
6	28.334	Ca^{2+}	0.5	12277267	83117

Comparison testing (Cation blank)

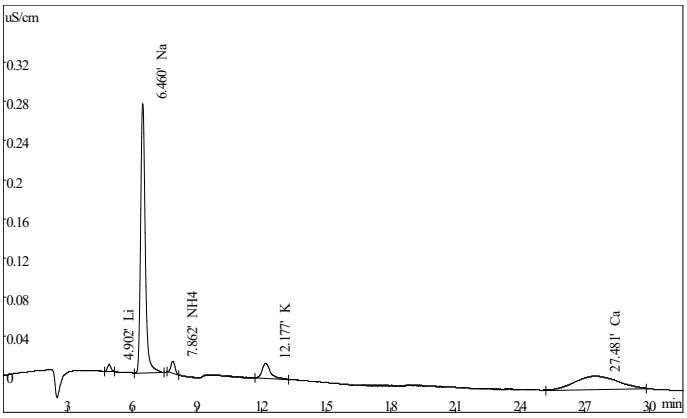

Figure 5. Chromatogram of cation blank.

Table 7: Data of cation blank

No.	Reten.time	Name	Concentration	Area	Peak height
1	4.902	Li^+	0.0008044	76504	7000
2	6.460	Na^+	0.1866	3826694	275023
3	7.862	NH_4^+	0.006448	154045	12199
4	12.177	K^+	0.03249	421938	15979
5	27.481	Ca^{2+}	0.07463	1832514	13531

Sample chromatogram (Cation)

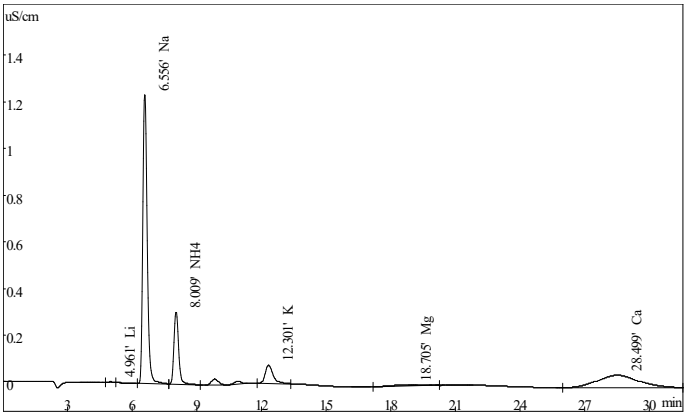

Figure 6. Chromatogram of cation in sample.

Standard chromatogram(Organic acid)

Standard chromatogram,As shown in below:

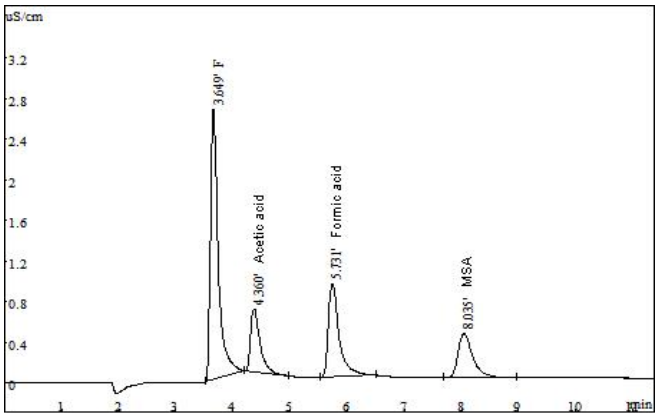

Figure 7. Chromatogram of organic acid standard sample.

Table 8: Data of organic acid standard solution

No.	Reten.time	Name	Concentration	Area	Peak height
1	3.649	F	1	24251170	2652791
2	4.360	Acetic acid	1	6866639	624090
3	5.731	Formic acid	1	11723651	923365
4	8.035	MSA	1.239	7429014	429109

Comparison testing (Organic acid blank)

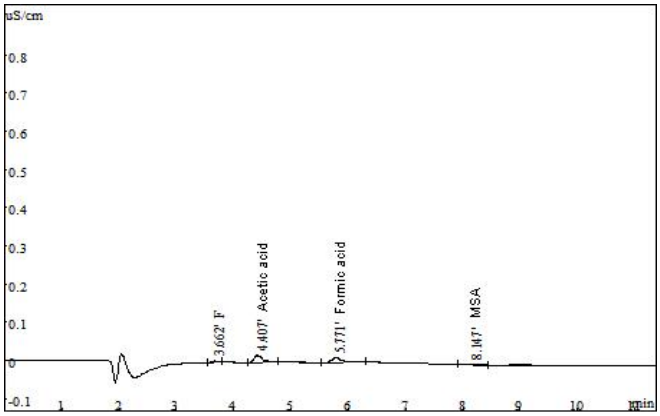

Figure 8. Chromatogram of organic acid blank.

Table 9: Data of organic acid blank

No.	Reten.time	Name	Concentration	Area	Peak height
1	3.662	F^-	0.001355	32871	4566
2	4.407	Acetic acid	0.03596	246933	21908
3	5.771	Formic acid	0.01702	199494	14975
4	8.147	MSA	0.007238	43401	2512

Sample chromatogram (Organic acid)

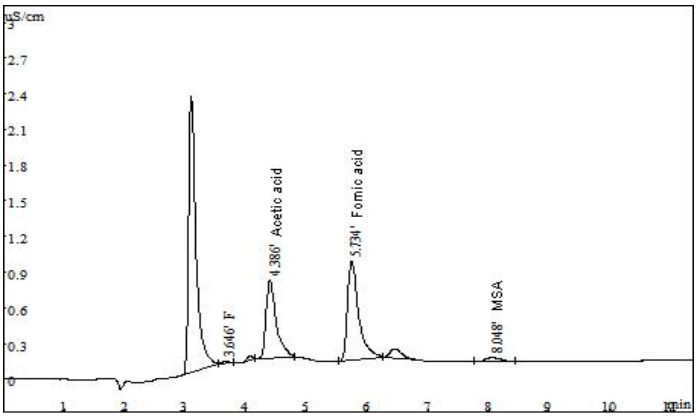

Figure 9. Chromatogram of organic acid in sample

Results and calculations

Table 10:Sample test result

Concentration (μg/cm²)							
Anion	F^-	Cl^-	NO_2^-	Br^-	NO_3^-	SO_4^{2-}	PO_4^{3-}
Concentration	0.0007859	0.2035	ND	0.01177	0.07052	0.02375	0.06358
Cation	Li^+	Na^+	NH_4^+	K^+	Mg^{2+}	Ca^{2+}	
Concentration	ND	0.1227	0.03614	0.02491	0.002893	0.04727	
Organic acid	Acetic acid	Formic acid	MSA	Malic acid	Succinic acid	Adipic acid	Phthalic acid
Concentration	0.2047	0.1582	0.01261	ND	ND	0.05501	ND

Remarks:

(1) Nd means no detection or lower than the detection limit, or lower than the control group;

(2) Ion content on circuit board surface（μG / cm2) = concentration of extraction solution (mg / L) * 250 ml / surface area of circuit board (cm2), and the surface area of circuit board is calculated as 1255.6 cm2;

(3) Because there are various components on the circuit board with different size bumps, the extraction efficiency of isopropanol water solvent may be affected. The results are for reference only;

(4) The test results of different methods and laboratories will be different.

Precautions

As the organic acid sample is easy to deteriorate, the organic acid mixed standard in this experiment should be used and prepared now. The circuit board extract should be injected for analysis as soon as possible and stored at 4 ℃ for refrigeration if necessary; It is easy to be polluted during the experiment, and the experimental personnel are required to operate in strict accordance with the operating procedures.

Feasibility analysis and conclusion

Through the above experiments, it is proved that the detection method has good separation and is suitable for the determination of the content of the components to be measured in the sample.