Emission Spectra Sheets of MH-5000 s2086

14 Feb. 2013
Purpose: These sheets show emission peaks at each element. You can compare peaks of same element and other elements.

Caution: Because spectra depends instrument and cuvette, these sheets are only one sample data.

Instrument: MH-5000 series

Solution: Pure solvent or 1000 mg/L single element standard and diluted solution with same solvent.

In case of low electrical conductivity or alkaline, acid is added to the solution.

More than 1000 mg/L Na, K, Mg, Ca and I solution are produced by NaCl, KCl, MgCl₂, CaCl₂ and KI.

Caution: High concentration Cr or Fe cause trouble because they produce oxide in narrow channel.

Conditions: Voltage, charged term and iteration count are adjusted. They depend on spectrometer, cuvette, solution and peak height.

Note:

Example 1: Simple line

<table>
<thead>
<tr>
<th>Wavelength [nm]</th>
<th>Emission intensity [a.u.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>535.046 nm (I)</td>
<td>30×10⁻³</td>
</tr>
</tbody>
</table>

Example 2: Multiple lines

<table>
<thead>
<tr>
<th>Wavelength [nm]</th>
<th>Emission type</th>
<th>Emission intensity [a.u.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>351.924 nm (I)</td>
<td>Atomic line</td>
<td>1 mg/L Tl</td>
</tr>
<tr>
<td>352.943 nm ( )</td>
<td>Ionic line</td>
<td>1000 mg/L Tl</td>
</tr>
</tbody>
</table>

Ref.


Molecule spectra:
# Emission Spectra Sheets of MH-5000 s2086

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|
| 1 | H |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |
| 2 | Li | Be |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |
| 3 | Na | Mg |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |
| 4 | K  | Ca | Sc | Ti | V  | Cr | Mn | Fe | Co | Ni | Cu | Zn | Ga | Ge | As | Se | Br | Kr |
| 5 | Rb | Sr | Y  | Zr | Nb | Mo | Tc | Ru | Rh | Pd | Ag | Cd | In | Sn | Sb | Te | I  | Xe |
| 6 | Cs | Ba |   | Hf | Ta | W  | Re | Os | Ir | Pt | Au | Hg | Tl | Pb | Bi | Po | At | Rn |
| 7 | Fr | Ra |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

**Explanatory notes**
- **Li**: Detected
- **I**: Detected, small peak
- **Be**: Not detected
- **H**: Unmeasured

* **La**, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu
** **Ac, Th, Pa, U, Np, Pu, Am, Cm, Bk, Cf, Es, Fm, Md, No, Lr
<table>
<thead>
<tr>
<th>Name</th>
<th>Note</th>
<th>Revised</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCl</td>
<td>Solvent</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>HNO₃</td>
<td>Solvent</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>H₂SO₄</td>
<td>Solvent</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Ag</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Al</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>As</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Au</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Ba</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Be</td>
<td>Not detected. Detected with s2035.</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Bi</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Ca - 1</td>
<td>Low concentration</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Ca - 2</td>
<td>High concentration</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Cd</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Co</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Cr</td>
<td>Be careful about generation of oxide.</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Cs</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Cu</td>
<td>Caution: OH 308.9 nm maybe overlap.</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Eu</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Fe</td>
<td>Be careful about generation of oxide.</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Ga</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Ge</td>
<td>Detected, small peak</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Hg</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>I</td>
<td>Detected, in case of more than 1000 mg/L.</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>In</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Ir</td>
<td>Not detected. Detected with s2035.</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>K - 1</td>
<td>Low concentration</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>K - 2</td>
<td>High concentration</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>La</td>
<td>Detected, small peak</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Li</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Mg - 1</td>
<td>Low concentration</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Mg - 2</td>
<td>High concentration. Detected, unknown peaks</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Mn</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Mo</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Na - 1</td>
<td>Low concentration</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Na - 2</td>
<td>High concentration</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Ni</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>P</td>
<td></td>
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</tr>
<tr>
<td>Pb</td>
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<td>Pd</td>
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<tr>
<td>Pt</td>
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<td>Rb</td>
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<td>14 Feb. 2013</td>
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<tr>
<td>Rh</td>
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<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Ru</td>
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<td>14 Feb. 2013</td>
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<tr>
<td>Sb</td>
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<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Sc</td>
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<td>14 Feb. 2013</td>
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<tr>
<td>Se</td>
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<td>14 Feb. 2013</td>
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<tr>
<td>Sn</td>
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<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Sr</td>
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<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Tb</td>
<td>Detected, small peak</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Te</td>
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<td>14 Feb. 2013</td>
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<tr>
<td>Tl</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Yb</td>
<td>Detected, small molecular spectra</td>
<td>14 Feb. 2013</td>
</tr>
<tr>
<td>Zn</td>
<td></td>
<td>14 Feb. 2013</td>
</tr>
</tbody>
</table>
**Spectra [T00090E]**

**HCl**

MH-5000 s2086  Conditions:  
500 V, (ON: 1 ms / OFF: 120 ms) × 60 pulses ... 11.6 mol/L

600 V, (ON: 2 ms / OFF: 130 ms) × 20 pulses ... 6 mol/L

750 V, (ON: 2 ms / OFF: 40 ms) × 20 pulses ... 0.1 mol/L

---

**LEP: Liquid Electrode Plasma**

**Emission intensity [a.u.]**

**Wavelength [nm]**

- **11.6 mol/L HCl**
- **6 mol/L HCl**
- **0.1 mol/L HCl**
HNO₃

MH-5000 s2086  Conditions:  
650 V, (ON: 2 ms / OFF: 80 ms) × 40 pulses ... 13.3 mol/L
600 V, (ON: 2 ms / OFF: 120 ms) × 50 pulses ... 6 mol/L
750 V, (ON: 2 ms / OFF: 40 ms) × 20 pulses ... 0.1 mol/L

Emission intensity [a.u.]
Wavelength [nm]

- H 656.285 nm ( )
- O 777.193 nm (I)
- O 844.638 nm (I)
- H 486.133 nm ( )
- NH 336.01 nm
- H 434.047 nm ( )
- OH 308.9 nm
- OH 282.90 nm
- OH 288.23 nm
- OH 282.21 nm
- OH 308.9 nm
- H 434.047 nm ( )
- O 777.193 nm (I)
- O 844.638 nm (I)
MH-5000 s2086  Conditions:  
600 V, (ON: 1 ms / OFF: 100 ms) × 30 pulses ... 18 mol/L
600 V, (ON: 1 ms / OFF: 100 ms) × 40 pulses ... 4 mol/L
750 V, (ON: 2 ms / OFF: 40 ms) × 20 pulses ... 0.1 mol/L

H$_2$SO$_4$

LepiCuve-C

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**Emission intensity [a.u.]**

- 18 mol/L H$_2$SO$_4$
- 4 mol/L H$_2$SO$_4$
- 0.1 mol/L H$_2$SO$_4$

**Wavelength [nm]**

- H 434.047 nm (I)
- H 486.133 nm (I)
- H 656.285 nm (I)
- O 777.193 nm (I)
- O 844.683 nm (I)
- OH 262.21 nm
- OH 282.90 nm
- OH 288.23 nm
- OH 308.9 nm

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**Notes:**

- Spectra [T00090E]
- LEP: Liquid Electrode Plasma
**Ag**

MH-5000 s2086  Conditions: 650 V, (ON: 2 ms / OFF: 50 ms) × 10 pulses

LepiCuve-C

---

**Emission intensity [a.u.]**

<table>
<thead>
<tr>
<th>Wavelength [nm]</th>
<th>1000 mg/L Ag</th>
<th>1 mg/L Ag</th>
<th>0 mg/L Ag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ag 328.068 nm (I)</td>
<td>![Graph Point]</td>
<td>![Graph Point]</td>
<td>![Graph Point]</td>
</tr>
<tr>
<td>Ag 338.289 nm ( )</td>
<td>![Graph Point]</td>
<td>![Graph Point]</td>
<td>![Graph Point]</td>
</tr>
<tr>
<td>Ag 520.907 nm (I)</td>
<td>![Graph Point]</td>
<td>![Graph Point]</td>
<td>![Graph Point]</td>
</tr>
<tr>
<td>Ag 546.549 nm (I)</td>
<td>![Graph Point]</td>
<td>![Graph Point]</td>
<td>![Graph Point]</td>
</tr>
</tbody>
</table>

**LEP: Liquid Electrode Plasma**
Al

MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 30 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

1000 mg/L Al
200 mg/L Al
0 mg/L Al
in 0.2 mol/L HNO₃

Al 394.403 nm (I) + Al 396.153 nm (I)
As

MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 20 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

900 mg/L As
100 mg/L As
0 mg/L As
in 0.1 mol/L HCl

As 228.812 nm (I)
As 234.984 nm (I)
As 249.291 nm (I)
AsO 256.52 nm
As 274.450 nm (I)
As 278.020 nm (I)
Na 588.995 nm
Na 819.481 nm
Au

MH-5000 s2086  Conditions: 650 V, (ON: 2 ms / OFF: 60 ms) × 20 pulses
LepiCuve-C

Au 242.795 nm (I)
Au 267.595 nm (I)
Au 274.826 nm (I/II)
+ Au 274.885 nm (II)
Au 479.260 nm (I)

1000 mg/L Au
100 mg/L Au
0 mg/L Au
0 mg/L Au in 1 mol/L HCl

Emission intensity [a.u.]
Wavelength [nm]
MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 20 pulses

LepiCuve-C

**Spectra [T00090E]**

**LEP: Liquid Electrode Plasma**

- **Conditions:** 750 V, (ON: 2 ms / OFF: 40 ms) × 20 pulses

**Graph Details:**
- **Emission intensity [a.u.]**
- **Wavelength [nm]**

- **Emission peaks:**
  - B 249.678 nm (I)
  - BO$_2$ 471.0 nm
  - BO$_2$ 493.0 nm
  - BO$_2$ 518.0 nm
  - BO$_2$ 545.0 nm
  - BO$_2$ 580.0 nm

**Graph Labels:**
- **Graph Legend:**
  - Red: 900 mg/L B
  - Green: 300 mg/L B
  - Dot: 0 mg/L B

**Chemical Species:**
- B
- BO$_2$

**Concentration Bounds:**
- 900 mg/L B
- 300 mg/L B
- 0 mg/L B

**Medium:**
- 0.1 mol/L HNO$_3$
Ba

MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 40 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

1000 mg/L Ba
100 mg/L Ba
0 mg/L Ba
in 0.5 mol/L HNO₃

Ba 455.404 nm (II)
Ba 493.409 nm (II)
Ba 553.555 nm (I)
MH-5000 s2086  Conditions: 700 V, (ON: 2 ms / OFF: 50 ms) × 10 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

1000 mg/L Be
0 mg/L Be
in 0.5 mol/L HNO₃
N.D.
MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 50 ms) × 10 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

Bi 222.825 nm (I)
Bi 412.153 nm (I)
Bi 472.255 nm (I)
Bi 520.929 nm (II)

1000 mg/L Bi
100 mg/L Bi
0 mg/L Bi
in 0.5 mol/L HNO₃

LEP: Liquid Electrode Plasma
MH-5000 s2086 Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 20 pulses

LepiCuve-C

**Emission intensity [a.u.]**

**Wavelength [nm]**

- Ca 393.366 nm (II)
- Ca 396.847 nm (II)
- Ca 422.673 nm (I)
- CaOH 554 nm (Calcium oxide: 598 - 637 nm)
- CaOH 623 nm (Calcium oxide: 598 - 637 nm)
- Ca 644.981 nm ()
- Ca 645.560 nm ()

NIST Atomic Spectra Database Lines Data
MH-5000 s2086 Conditions: 500 V, (ON: 2 ms / OFF: 50 ms) × 20 pulses
LepiCuve-C

Ca

Emission intensity [a.u.]

Wavelength [nm]

200 300 400 500 600 700 800

Ca 396.847 nm (II)
Ca 593.40 nm
Ca 580.99 nm
CaOH 554 nm (553 - 557 nm)

Ca 644.981 nm ( ) + Ca 645.560 nm ( )

NIST Atomic Spectra Database Lines Data
Cd

MH-5000 s2086 Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 10 pulses

LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

1000 mg/L Cd
10 mg/L Cd
0 mg/L Cd in 0.1 mol/L HNO₃

Cd 228.802 nm (I)
+ Cd 226.502 nm (II)
Cd 214.438 nm (II)
Cd 236.106 nm (I)
Cd 340.365 nm (I)
Cd 346.620 nm (I)
Cd 361.051 nm (I)
Cd 467.816 nm (I)
Cd 479.992 nm (I)
Cd 508.582 nm (I)
Cd 643.847 nm (I)
Co

MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 10 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

Co 240.725 nm (I)
+ Co 241.162 nm (I)

Co 252.136 nm ( )

Co 290.725 nm (I)

Co 302.136 nm (I)

Co 340.512 nm (I)

Co 345.351 nm (I)

Co 350.228 nm (I)

Co 356.938 nm (I)

Co 384.547 nm (I)

Co 387.312 nm (I)

Co 389.408 nm (I)

Co 399.531 nm (I)

Co 412.132 nm (I)
Cr

MH-5000 s2086  Conditions: 800 V, (ON: 2 ms / OFF: 60 ms) × 20 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

- 50 mg/L Cr
- 5 mg/L Cr
- 0 mg/L Cr

in 0.1 mol/L HCl

K 766.491 nm (I)
K 769.898 nm (I)
Cr 425.435 nm (I)
Cr 427.480 nm (I)
Cr 520.604 nm (I)
Cr 276.654 nm (II)
Cs

MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 40 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

Cs 852.110 nm (I)

0 5 10 15 20 25 30

0 200 400 600 800

900 mg/L Cs
100 mg/L Cs
0 mg/L Cs

in 0.1 mol/L HNO₃
Spectra [T00090E]

MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 10 pulses
LepiCuve-C

Cu

Emission intensity [a.u.]
Wavelength [nm]

- 1000 mg/L Cu
- 500 mg/L Cu
- 0 mg/L Cu
- in 0.1 mol/L HNO₃

Cu 324.754 nm (I)
Cu 327.396 nm (I)
Cu 223.008 nm (I/II)
Cu 218.141 nm (II) + Cu 219.958 nm (I)
Cu 510.554 nm (I)
Cu 515.324 nm (I)
Cu 521.820 nm (I)
Eu

MH-5000 s2086  Conditions: 650 V, (ON: 2 ms / OFF: 60 ms) × 20 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

- 1000 mg/L Eu
- 500 mg/L Eu
- 0 mg/L Eu
- 0 mg/L Eu
in 1 mol/L HCl

Eu 381.966 nm (II)
Eu 420.505 nm (II)
Eu 459.402 nm ( )
Eu 462.621 nm ( )
Eu 466.037 nm ( )
Fe

MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 80 ms) × 20 pulses
LepiCuve-C

[Graph showing emission intensity vs. wavelength for different concentrations of Fe in 0.2 mol/L HNO₃.]

- 100 mg/L Fe
- 10 mg/L Fe
- 0 mg/L Fe
- 0 mg/L Fe

- Emission intensity [a.u.]
- Wavelength [nm]

Fe 248.419 nm (I) + Fe 248.815 nm (I)
Fe 252.285 nm (I) + Fe 252.429 nm (I)
Fe 271.903 nm (I)
Fe 373.487 nm (I) + Fe 373.713 nm (I) + Fe 374.949 nm (I)
Fe 382.043 nm (I) + Fe 382.588 nm (I)
MH-5000 s2086  Conditions: 650 V, (ON: 2 ms / OFF: 60 ms) × 20 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

Ga 403.298 nm (I)
Ga 417.206 nm (I)

1000 mg/L Ga
10 mg/L Ga
0 mg/L Ga
in 1 mol/L HNO₃
MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 50 ms) × 20 pulses

LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

Ge 265.118 nm (I)
Ge 275.459 nm ( )
K 404.414 nm
Na 588.995 nm
K 766.491 nm
+ K 769.898 nm

980 mg/L Ge
490 mg/L Ge
0 mg/L Ge

in 0.196 mol/L KOH, 0.266 mol/L HNO₃
MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 10 pulses

LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

Hg 253.652 nm (I)
Hg 365.015 nm (I) + Hg 366.328 nm (I)
Hg 404.656 nm (I)
Hg 435.835 nm (I)
Hg 546.075 nm (I)
Hg 576.959 nm (I)
Hg 579.065 nm (I)

1000 mg/L Hg
10 mg/L Hg
0 mg/L Hg
in 0.1 mol/L HNO₃
MH-5000 s2086  Conditions: 850 V, (ON: 2 ms / OFF: 40 ms) × 40 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

- 29 g/L I (KI aq.)
- 2.9 g/L I (KI aq. 10% + 0.1 mol/L HCl 90%)
- 0 g/L I (0.1 mol/L HCl)

K 766.491 nm (I)
+ K 769.898 nm (I)

I 206.238 nm (I)

I 516.119 nm (II)

I 511.929 nm (I)

I 534.515 nm (I)

I 608.246 nm (I)
Spectra [T00090E]

In

MH-5000 s2086  Conditions: 600 V, (ON: 2 ms / OFF: 60 ms) × 10 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

1000 mg/L In
10 mg/L In
0 mg/L In
in 1 mol/L HNO₃

In 325.609 nm (I)
In 410.177 nm (I)
In 451.130 nm (I)
MH-5000 s2086  Conditions: 650 V, (ON: 2 ms / OFF: 110 ms) × 20 pulses
LepiCuve-C

Emission intensity [a.u.]

| Wavelength [nm] | 0  | 5  | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 |
|-----------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1000 mg/L Ir    | N.D. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 500 mg/L Ir     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 0 mg/L Ir       |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| in 3.5 mol/L HCl|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

LEP: Liquid Electrode Plasma
MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 20 pulses

LepiCuve-C

Conditions:
- K 769.898 nm (I)
- K 766.491 nm (I)

- 900 mg/L K
- 10 mg/L K
- 0 mg/L K

in 0.1 mol/L HNO₃
MH-5000 s2086

Conditions: 500 V, (ON: 2 ms / OFF: 50 ms) × 20 pulses

K

LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

100 g/L K (KCl aq.)
10 g/L K (KCl aq. 10% + 0.5 mol/L HCl 90%)
0 g/L K (0.5 mol/L HCl)

K 766.491 nm (I)
+ K 769.898 nm (I)
K 693.898 nm (I)
K 691.130 nm (I)
Na 588.995 nm (I)
MH-5000 s2086  Conditions: 650 V, (ON: 2 ms / OFF: 60 ms) × 20 pulses
LepiCuve-C

La 437.810 nm (II)

In 1 mol/L HCl

Emission intensity [a.u.]

Wavelength [nm]

0 5 10 15 20 25 30
200 300 400 500 600 700 800 900

1000 mg/L La
500 mg/L La
0 mg/L La

LEP: Liquid Electrode Plasma
MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 10 pulses  LepICuve-C

LEP: Liquid Electrode Plasma

- Li 460.286 nm (I)
- Li 610.364 nm (I)
- Li 670.784 nm (I)
- Li 812.652 nm (I)

Emission intensity [a.u.]

Wavelength [nm]
**Spectra**

**MH-5000 s2086**  
**LepiCuve-C**

**Conditions:** 750 V, (ON: 2 ms / OFF: 40 ms) × 10 pulses

---

**Mg**

- **279.553 nm (II)**
- **280.270 nm (II)**
- **285.213 nm (I)**
- **383.231 nm (I)**
- **383.826 nm (I)**
- **518.362 nm (I)**
- **517.270 nm (I)**

**Wavelength [nm]**  
**Emission intensity [a.u.]**

**Graph:**
- **1000 mg/L Mg**
- **100 mg/L Mg**
- **0 mg/L Mg**

in 0.1 mol/L HNO₃
MH-5000 s2086  Conditions: 650 V, (ON: 2 ms / OFF: 40 ms) × 40 pulses

LepiCuve-C

**Mg**

- 13 g/L Mg (MgCl\textsubscript{2} aq.)
- 1.3 g/L Mg (MgCl\textsubscript{2} aq. 10% + 0.1 mol/L HCl 90%)
- 0 g/L Mg (0.1 mol/L HCl)

**Emission intensity [a.u.]**

**Wavelength [nm]**

- Mg 518.362 nm (I)
- Mg 517.270 nm (I)
- Mg 383.231 nm (I)
- Mg 383.826 nm (I)
- Mg 279.553 nm (II)
- Mg 280.270 nm (II)
- Mg 285.213 nm (I)
- Mg 285.213 nm (II)

**Unknown**

LEP: Liquid Electrode Plasma
Mn

MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 30 pulses

LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

- Mn 279.827 nm (I)
- Mn 259.373 nm (II)
- Mn 260.569 nm (II)
- Mn 257.610 nm (II)
- Mn 380.672 nm (I)
- Mn 382.351 nm (I)
- Mn 383.436 nm (I)
- Mn 383.978 nm (I)
- Mn 260.569 nm (II)
- Mn 403.076 nm (I)
- Mn 446.202 nm (I)
- Mn 475.404 nm (I)
- Mn 478.342 nm (I)
- Mn 482.352 nm (I)
- Mn 534.107 nm (I)
- Mn 602.180 nm (I)
- Mn 601.350 nm (I)

1000 mg/L Mn
10 mg/L Mn
0 mg/L Mn
in 0.1 mol/L HNO₃

LEP: Liquid Electrode Plasma
MH-5000 s2086  Conditions: 700 V, (ON: 2 ms / OFF: 60 ms) × 20 pulses
LepiCuve-C

Mo

Emission intensity [a.u.]

Wavelength [nm]

Mo 379.825 nm (I)
Mo 386.411 nm (I)

1000 mg/L Mo
500 mg/L Mo
0 mg/L Mo
in 0.4 mol/L HCl, 0.2 mol/L HNO₃
MH-5000 s2086  
Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 10 pulses

LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

900 mg/L Na
10 mg/L Na
0 mg/L Na
in 0.1 mol/L HNO₃

Na 588.995 nm (I)
+ Na 589.592 nm (I)
Na 819.481 nm (I)
Na 568.822 nm (I)
MH-5000 s2086  Conditions: 500 V, (ON: 2 ms / OFF: 50 ms) × 20 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

Na 330.232 nm (I)
Na 568.822 nm (I)
Na 588.995 nm (I)
+ Na 589.592 nm (I)
Na 819.481 nm (I)
Na 498.285 nm (I)
Na 514.909 nm (I)

100 g/L Na (NaCl aq.)
10 g/L Na (NaCl aq. 10% + 0.5 mol/L HCl 90%)
0 g/L Na (0.5 mol/L HCl)
MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 10 pulses

LepiCuve-C

Ni 231.234 nm (I) + Ni 232.003 nm (I)
Ni 300.249 nm (I)
Ni 336.957 nm (I)
Ni 338.057 nm (I)
Ni 341.477 nm (I)
Ni 346.165 nm (I)
Ni 351.505 nm (I) + Ni 352.454 nm (I)
Ni 356.637 nm (I)
Ni 361.939 nm (I) + Ni 361.046 nm (I)
Ni 385.830 nm (I)
LepiCuve-C

MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 40 pulses

Emission intensity [a.u.]

Wavelength [nm]

P 213.617 nm (I)
P 253.565 nm (I)
P 246.1 nm
K 766.491 nm (I)
K 769.898 nm (I)

900 mg/L P
500 mg/L P
0 mg/L P
in 0.1 mol/L HNO₃

LEP: Liquid Electrode Plasma
Spectra [T00090]

**Pb**

MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 20 pulses
LepiCuve-C

<table>
<thead>
<tr>
<th>Emission intensity [a.u.]</th>
<th>Wavelength [nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 mg/L Pb</td>
<td>257.726 nm (I)</td>
</tr>
<tr>
<td>10 mg/L Pb</td>
<td>220.351 nm (II)</td>
</tr>
<tr>
<td>0 mg/L Pb</td>
<td>247.638 nm (I)</td>
</tr>
</tbody>
</table>

in 0.1 mol/L HNO₃
**Pd**

MH-5000 s2086  
Conditions: 650 V, (ON: 2 ms / OFF: 60 ms) × 20 pulses

LepiCuve-C

---

**Emission intensity [a.u.]**

- 1000 mg/L Pd
- 100 mg/L Pd
- 0 mg/L Pd

**Wavelength [nm]**

- Pd 529.563 nm (I)
- Pd 516.384 nm (I)
- Pd 421.295 nm (I)
- Pd 395.864 nm (I)
- Pd 389.420 nm (I)
- Pd 383.229 nm (I)
- Pd 379.919 nm (I)
- Pd 369.034 nm (I)
- Pd 363.470 nm (I)
- Pd 360.955 nm (I)

**in 1 mol/L HNO₃**

**LEP:** Liquid Electrode Plasma
MH-5000 s2086

Conditions: 650 V, (ON: 2 ms / OFF: 60 ms) × 20 pulses

LEP: Liquid Electrode Plasma

Pt

Emission intensity [a.u.]

Wavelength [nm]

Pt 265.945 nm (I)
+ Pt 264.689 nm (I)
Pt 270.240 nm (I)
+ Pt 270.589 nm (I)
+ Pt 271.904 nm (I)
+ Pt 273.396 nm (I)

in 1 mol/L HCl

1000 mg/L Pt
500 mg/L Pt
0 mg/L Pt

0 5 10 15 20 25 30

200 300 400 500 600 700 800 900

30x10^3

20

10

5

25

300

1000 mg/L Pt
500 mg/L Pt
0 mg/L Pt

in 1 mol/L HCl

Pt 265.945 nm (I)
+ Pt 264.689 nm (I)
Pt 270.240 nm (I)
+ Pt 270.589 nm (I)
+ Pt 271.904 nm (I)
+ Pt 273.396 nm (I)
MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 30 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

- 900 mg/L Rb
- 10 mg/L Rb
- 0 mg/L Rb
in 0.1 mol/L HNO₃

Rb 780.023 nm (I)
Rb 794.760 nm (I)
O 777.193 nm (I)
Spectra

**LEP: Liquid Electrode Plasma**

**Conditions:** 650 V, (ON: 2 ms / OFF: 60 ms) × 20 pulses

**LepiCuve-C**

**Emission intensity [a.u.]**

<table>
<thead>
<tr>
<th>Wavelength [nm]</th>
<th>0 mg/L Rh</th>
<th>100 mg/L Rh</th>
<th>1000 mg/L Rh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rh 343.489 nm</td>
<td>( )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh 350.252 nm</td>
<td>(I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh 352.802 nm</td>
<td>(I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh 358.310 nm</td>
<td>(I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh 365.799 nm</td>
<td>(I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh 369.236 nm</td>
<td>(I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh 379.322 nm</td>
<td>(I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh 380.676 nm</td>
<td>(I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh 382.226 nm</td>
<td>(I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh 382.848 nm</td>
<td>(I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh 385.652 nm</td>
<td>(I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh 393.423 nm</td>
<td>(I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh 395.887 nm</td>
<td>(I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh 412.887 nm</td>
<td>(I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh 421.114 nm</td>
<td>(I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh 437.480 nm</td>
<td>(I)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rh 380.676 nm</td>
<td>(I)</td>
<td>+ Rh 382.226 nm</td>
<td></td>
</tr>
<tr>
<td>+ Rh 382.848 nm</td>
<td>(I)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**in 1 mol/L HCl**

**Micro Emission**
Ru

MH-5000 s2086  Conditions: 650 V, (ON: 2 ms / OFF: 110 ms) × 20 pulses
LepiCuve-C

Conditions: 650 V, (ON: 2 ms / OFF: 110 ms) × 20 pulses

Emission intensity [a.u.]

Wavelength [nm]

1000 mg/L Ru
100 mg/L Ru
0 mg/L Ru
in 3.5 mol/L HCl

Ru 273.435 nm (I)
Ru 359.302 nm (I) + Ru 359.619 nm (I)
Ru 366.135 nm (I)
Ru 372.803 nm (I)
Ru 379.890 nm (I)
Ru 419.990 nm (I)
Ru 455.451 nm (I)
MH-5000 s2086  Conditions: 650 V, (ON: 2 ms / OFF: 100 ms) \times 20 pulses
LepiCuve-C

Sb 206.838 nm (I)
Sb 217.589 nm (I)
Sb 231.147 nm (I)
Sb 252.854 nm (I)
Sb 259.806 nm (I)
Sb 276.994 nm ( )

Emission intensity [a.u.]
Wavelength [nm]

1000 mg/L Sb
100 mg/L Sb
0 mg/L Sb
in 2.5 mol/L HCl

LEP: Liquid Electrode Plasma
Sc

MH-5000 s2086  Conditions: 650 V, (ON: 2 ms / OFF: 60 ms) × 20 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

Sc 390.748 nm (I) + Sc 391.181 nm (I)
Sc 402.322 nm (I)
ScO 606.42 nm + ScO 607.25 nm + ScO 607.91 nm
ScO 603.61 nm + ScO 601.70 nm
ScO 610.16 nm + ScO 610.98 nm + ScO 611.60 nm

Sc 500 mg/L in 1 mol/L HNO₃

LEP: Liquid Electrode Plasma
MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 50 ms) × 10 pulses
LepiCuve-C

Emission intensity [a.u.]
Wavelength [nm]

Se 203.985 nm (I) + Se 206.279 nm (I)

1000 mg/L Se
100 mg/L Se
0 mg/L Se
in 0.5 mol/L HNO₃

LEP: Liquid Electrode Plasma
**Sn**

MH-5000 s2086  
Conditions: 650 V, (ON: 2 ms / OFF: 100 ms) × 20 pulses

LepiCuve-C

---

**Emission intensity [a.u.]**

- 1000 mg/L Sn
- 100 mg/L Sn
- 0 mg/L Sn

in 3 mol/L HCl

---

**Wavelength [nm]**

- Sn 235.485 nm ( )
- Sn 242.950 nm (I) + Sn 242.169 nm (I)
- Sn 230.915 nm (I)
- Sn 270.651 nm ( )
- Sn 303.412 nm (I)
- Sn 300.915 nm (I)
- Sn 380.100 nm ( )
- Sn 452.474 nm (I)
Sr
MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 50 ms) × 10 pulses
LepiCuve-C

Strontium oxide: 640.0 - 685.0 nm

- Sr 407.771 nm (II)
- Sr 421.552 nm (II)
- Sr 430.545 nm (I)
- Sr 460.733 nm (I)
- Sr 481.188 nm (I)
- SrOH 646.0 nm
- SrOH 650.0 nm
- SrOH 667.5 nm
- SrOH 682.0 nm
- SrOH 682.0 nm
- Sr 496.226 nm (I)
- Sr 548.084 nm (I)
- Sr 707.010 nm (I)
- Sr 707.010 nm (I)

1000 mg/L Sr
10 mg/L Sr
0 mg/L Sr
in 0.5 mol/L HNO₃
Tb

MH-5000 s2086  Conditions: 650 V, (ON: 2 ms / OFF: 60 ms) × 20 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

1000 mg/L Tb
500 mg/L Tb
0 mg/L Tb
in 1 mol/L HCl

Tb 540.206 nm ( )
- Tb 550.961 nm ( )
MH-5000 s2086  Conditions: 650 V, (ON: 2 ms / OFF: 60 ms) × 20 pulses
LepiCuve-C

Te 214.275 nm (I)
Te 225.904 nm (I)
Te 238.325 nm (I)
Spectra T00090

**LEP: Liquid Electrode Plasma**

**Conditions:** 650 V, (ON: 2 ms / OFF: 50 ms) × 10 pulses

**LepiCuve-C**

MH-5000 s2086

**Tl**

- **Tl 351.924 nm (I)**
- **Tl 352.943 nm (I)**
- **Tl 351.924 nm (I)**
- **Tl 377.572 nm ( )**
- **Tl 377.572 nm ( )**
- **Tl 535.046 nm (I)**
- **Tl 535.046 nm (I)**

**NIST Atomic Spectra Database Lines Data**

- **Tl 276.787 nm (I)**

**Emission intensity [a.u.]**

<table>
<thead>
<tr>
<th>Wavelength [nm]</th>
<th>Emission intensity [a.u.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>30 × 10^3</td>
</tr>
<tr>
<td>300</td>
<td>25</td>
</tr>
<tr>
<td>400</td>
<td>20</td>
</tr>
<tr>
<td>500</td>
<td>15</td>
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<tr>
<td>600</td>
<td>10</td>
</tr>
<tr>
<td>700</td>
<td>5</td>
</tr>
<tr>
<td>800</td>
<td>0</td>
</tr>
<tr>
<td>900</td>
<td>0</td>
</tr>
</tbody>
</table>

- **1000 mg/L Tl**
- **1 mg/L Tl**
- **0 mg/L Tl**

*in 0.5 mol/L HNO₃*
MH-5000 s2086  Conditions: 650 V, (ON: 2 ms / OFF: 60 ms) × 20 pulses

LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

YO 597.22 nm + YO 598.77 nm
YO 614.84 nm

1000 mg/L Y
500 mg/L Y
0 mg/L Y
in 1 mol/L HCl

LEP: Liquid Electrode Plasma
MH-5000 s2086  Conditions: 650 V, (ON: 2 ms / OFF: 60 ms) × 20 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

1000 mg/L Yb
500 mg/L Yb
0 mg/L Yb
in 1 mol/L HCl

\[ \text{Yb } 369.420 \text{ nm} \]
\[ \text{Yb } 398.799 \text{ nm} \]
Zn

MH-5000 s2086  Conditions: 750 V, (ON: 2 ms / OFF: 40 ms) × 20 pulses
LepiCuve-C

Emission intensity [a.u.]

Wavelength [nm]

200 300 400 500 600 700 800

Zn 202.551 nm (II)
Zn 206.191 nm (II)
Zn 213.856 nm (I)
Zn 468.014 nm (I)
Zn 472.216 nm (I)
Zn 481.053 nm (I)
Zn 636.235 nm (I)

LEP: Liquid Electrode Plasma