Product Information

60403 Potassium ionophore I
(Valinomycin)
Selectophore®, function tested

Electrochemical Transduction
Ion-Selective Electrodes

Application 1 and Sensor Type
Assay of $K^+$ activity in diluted urine, whole blood, plasma, serum and aqueous solutions with solvent polymeric membrane electrodes based on Potassium ionophore I.

Recommended Membrane Composition

```
1.00 wt% Potassium ionophore I (60403)
65.50 wt% Bis(1-butylpentyl) decane-1,10-diyl diglutarate (ETH 469) (30585)
0.50 wt% Potassium tetrakis(4-chlorophenyl)borate (60591)
33.00 wt% Poly(vinyl chloride) high molecular weight (81392)
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The use of bis(1-butylpentyl) adipate (BBPA) or bis(2-ethylhexyl)sebacate (DOS) leads to membrane electrodes of similar performance.

Recommended Cell Assembly

Reference || sample solution || liquid membrane | 0.004 M KCl | AgCl, Ag

Electrode Characteristics and Function

Selectivity coefficients $\log K_{K,M}^\text{Pot}$:

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<table>
<thead>
<tr>
<th>$\log K_{K,F}^\text{Pot}$</th>
<th>Required$^b$)</th>
<th>Found$^c$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\log K_{K,Na}^\text{Pot}$</td>
<td>&lt;-2.8</td>
<td>-3.4</td>
</tr>
<tr>
<td>$\log K_{K,Mg}^\text{Pot}$</td>
<td>&lt;-2.8</td>
<td>-5.7</td>
</tr>
<tr>
<td>$\log K_{K,Ca}^\text{Pot}$</td>
<td>&lt;-2.9</td>
<td>-5.2</td>
</tr>
</tbody>
</table>
```

Stability:
- Drift [mV h$^{-1}$]: 0.01
- Standard deviation [mV]: <-0.46
- Reproducibility [mV]: 0.16

Lifetime:
- $\log P_{TLC}^\text{Pot}$ ionophore: >8.4
- $\log P_{TLC}^\text{Pot}$ plasticizer: >12.8

$^b$) for measurements in blood (1% interference, worst case)$^6,7$
$^c$) membrane without potassium tetrakis(4-chlorophenyl)borate
$^d$) lipophilicity, determined by thin-layer chromatography$^8$
Application 2 and Sensor Type\textsuperscript{4,9,10}

Assay of K\textsuperscript{+} activity in undiluted urine, whole blood, plasma, serum, and aqueous solutions with solvent polymeric membrane electrodes based on Potassium ionophore I.

**Recommended Membrane Composition**

\begin{itemize}
  \item 2.50 wt\% Potassium ionophore I \textcolor{blue}{(60403)}
  \item 83.00 wt\% Siloprene K \textcolor{blue}{1000} \textcolor{blue}{(85417)}
  \item 14.50 wt\% Siloprene Crosslinking Agent K11 \textcolor{blue}{(85418)}
\end{itemize}

**Recommended Cell Assembly**

Reference || sample solution || liquid membrane | 0.1 M KCl | AgCl, Ag

**Electrode Characteristics and Function**

Selectivity coefficients $\log K_{\text{ MLP}}^{\text{ Pot}}$ as obtained by the separate solution method.

<table>
<thead>
<tr>
<th>Required\textsuperscript{a)}</th>
<th>Found</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\log K_{\text{ MLP}}^{\text{ Pot}}$</td>
<td>$&lt;-2.8$</td>
</tr>
<tr>
<td>$\log K_{\text{ MLP}}^{\text{ Li}}$</td>
<td>$&lt;-1.7$\textsuperscript{b)}</td>
</tr>
<tr>
<td>$\log K_{\text{ MLP}}^{\text{ Na}}$</td>
<td>$&lt;-3.6$</td>
</tr>
<tr>
<td>$\log K_{\text{ MLP}}^{\text{ Mg}}$</td>
<td>$&lt;-2.8$</td>
</tr>
<tr>
<td>$\log K_{\text{ MLP}}^{\text{ Ca}}$</td>
<td>$&lt;-2.9$</td>
</tr>
</tbody>
</table>

Lifetime: $\log P_{\text{TLC}}^{\text{ ionophore}}$ >8.4 | 8.6

\textsuperscript{a)} for measurements in blood (1% interference, worst case)\textsuperscript{5,7}

\textsuperscript{b)} therapeutical Li\textsuperscript{+} concentrations

\textsuperscript{c)} lipophilicity, determined by thin-layer chromatography\textsuperscript{8}

Application 3 and Sensor Type\textsuperscript{11-14}

Assay of K\textsuperscript{+} activity for cardiovascular application with biocompatible solvent polymeric membrane electrodes and related microfabricated sensor arrays based on Potassium ionophore I.

**Recommended Membrane Composition**

\begin{itemize}
  \item 1.00 wt\% Potassium ionophore I \textcolor{blue}{(60403)}
  \item 0.50 wt\% Potassium tetrakis(4-chlorophenyl)borate \textcolor{blue}{(60591)}
  \item 49.50 wt\% Bis(2-ethylhexyl)sebacate \textcolor{blue}{(84818)}
  \item 49.00 wt\% Poly(vinyl chloride) carboxylated (1.8\% carboxyl content) \textcolor{blue}{(81395)}
\end{itemize}

**Electrode Characteristics and Function**

Selectivity coefficients $\log K_{\text{ MLP}}^{\text{ Pot}}$ as obtained by the separate solution method (0.1 M solutions of the chlorides).

<table>
<thead>
<tr>
<th>$\log K_{\text{ MLP}}^{\text{ Pot}}$</th>
<th>$\log K_{\text{ MLP}}^{\text{ Na}}$</th>
<th>$\log K_{\text{ MLP}}^{\text{ Ca}}$</th>
<th>$\log K_{\text{ MLP}}^{\text{ NH}_4}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$-3.98$</td>
<td>$-3.56$</td>
<td>$-4.30$</td>
<td>$-1.81$</td>
</tr>
</tbody>
</table>

Slope of linear regression: 59-60 mV/dec

Detection limit (KCl ion background of 140 mM Na\textsuperscript{+}): 4·10\textsuperscript{-6} M K\textsuperscript{+}

Membrane resistance (10\textsuperscript{-2} M KCl at pH 7.0 with Tris buffer): 3.17 M\text{Ω}

Application 4 and Sensor Type\textsuperscript{15,16}

Assay of K\textsuperscript{+} activity with double-matrix membrane ion-selective electrodes based on Potassium ionophore I.

**Recommended Membrane Composition**

\begin{itemize}
  \item 2.00 wt\% Potassium ionophore I \textcolor{blue}{(60403)}
  \item 0.50 wt\% Potassium tetrakis(4-chlorophenyl)borate \textcolor{blue}{(60591)}
  \item 64.70 wt\% Bis(2-ethylhexyl)sebacate \textcolor{blue}{(84818)}
  \item 32.80 wt\% Poly(vinyl chloride) high molecular weight \textcolor{blue}{(81392)}
\end{itemize}
Recommended Cell Assembly
Ag, AgCl | 3 M KCl || 0.3 M NH₄NO₃ || sample solution || liquid membrane | 0.1 M KCl | AgCl, Ag

Electrode Characteristics and Function
Selectivity coefficients \( \log K_{\text{Pot}}^{\text{Li}} \) as obtained by the separate solution method (0.1 M solutions of the chlorides).

\[
\begin{align*}
\log K_{\text{Pot}}^{\text{Li}} &\approx -4.3 \\
\log K_{\text{Pot}}^{\text{Na}} &\approx -4.2 \\
\end{align*}
\]

Slope of linear regression: 58 mV (1.8·10⁻⁵ to 10⁻¹ M K⁺)  
Detection limit: 3·10⁻⁶ M K⁺  
Lifetime: >1 month

Ion-selective Field Effect Transistors

Application 1 and Sensor Type\(^{17,18,19}\)
Assay of K⁺ activity with Urushi matrix ion-selective field effect transistors of good durability based on Potassium ionophore I.

Recommended Membrane Composition
0.50 wt% Potassium ionophore I (60403)  
49.25 wt% Bis(2-ethylhexyl) phthalate (80030)  
0.25 wt% Potassium tetrakis((4-chlorophenyl)borate (60591)  
50.00 wt% Urushi (polymer from lacquer tree)

Electroanalytical Characteristics
Selectivity coefficients \( \log K_{\text{Pot}}^{\text{Li}} \) as obtained by the mixed solution method.

\[
\begin{align*}
\log K_{\text{Pot}}^{\text{Mg}} &\approx -4.6 \\
\log K_{\text{Pot}}^{\text{Ca}} &\approx -4.5 \\
\log K_{\text{Pot}}^{\text{Na}} &\approx -4.2 \\
\log K_{\text{Pot}}^{\text{NH}_4} &\approx -1.7 \\
\end{align*}
\]

Slope of linear regression: 53 mV (10⁻⁴ to 1 M K⁺)

Application 2 and Sensor Type\(^{18,19,20}\)
Assay of K⁺ activity with silicon rubber matrix ion-selective field effect transistors based on Potassium ionophore I.

Recommended Membrane Composition
3.0 wt% Potassium ionophore I (60403)  
88.0 wt% Siloprene K 1000 (85417)  
9.0 wt% Siloprene crosslinking agent K 11 (85418)

Electroanalytical Characteristics
Selectivity coefficients \( \log K_{\text{Pot}}^{\text{Li}} \) <-3.7 as obtained by the fixed interference method (0.1 M of the chlorides).

Lifetime: ~2 months
Ion-selective Conductometric Microsensors

**Application**
Assay of K⁺ activity with ion-selective conductometric microsensors (ISCOM). Detection is accomplished by measurement of the bulk conductance of the solvent polymeric membrane based on Potassium ionophore I.

**Recommended Membrane Composition**
- 5.0 wt% Potassium ionophore I (60403)
- 30.0 wt% Poly(vinyl chloride) high molecular weight (81392)
- 65.0 wt% 2-Nitrophenyl octyl ether (73732)

**Electroanalytical Characteristics**
Selectivity coefficients $\log K_{Pot}^M$ as obtained by the mixed solution method.

<table>
<thead>
<tr>
<th>Selectivity Coefficient</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\log K_{K,Na}^{Pot}$</td>
<td>-2.6</td>
</tr>
<tr>
<td>$\log K_{K,Na}^{Opt}$</td>
<td>-1.3</td>
</tr>
<tr>
<td>$\log K_{K,Li}^{Pot}$</td>
<td>-3.0</td>
</tr>
<tr>
<td>$\log K_{K,Li}^{Opt}$</td>
<td>-0.5</td>
</tr>
</tbody>
</table>

- Membrane specific conductivity: 0.5 to 5 µS/cm
- Frequency range: 0.5 to 20 kHz
- Membrane thickness: ~2 mm
- Detection limit: $>10^{-6}$ M K⁺
- Response time: ~1 s

**Optical Transduction**

**Application 1 and Sensor Type**
Assay of K⁺ activity in aqueous pH buffered solutions and in diluted blood plasma with solvent polymeric optode membranes based on Chromoionophore I (ETH 5294) and Potassium ionophore I.

**Recommended Membrane Composition**
- 0.48 wt% Chromoionophore I (27086)
- 1.00 wt% Potassium ionophore I (60403)
- 0.44 wt% Potassium tetrakis(4-chlorophenyl)borate (60591)
- 66.05 wt% Bis(1-ethylhexyl)sebacate (84818)
- 32.03 wt% Poly(vinyl chloride) high molecular weight (81392)

**Recommended pH Buffer**
0.16 M sodium acetate, adjusted with acetic acid to pH 5.1 for recording the calibration curve to pH 5.5 for diluting blood plasma samples.

**Optode Characteristics and Function**
Selectivity coefficients $\log K_{K,M}^{Opt}$ as obtained by the fixed interference method in pH buffered solutions.

<table>
<thead>
<tr>
<th>Selectivity Coefficient</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\log K_{K,Na}^{Opt}$</td>
<td>-3.5</td>
</tr>
<tr>
<td>$\log K_{K,Mg}^{Opt}$</td>
<td>-4.0</td>
</tr>
<tr>
<td>$\log K_{K,Na}^{Opt}$</td>
<td>-3.7</td>
</tr>
<tr>
<td>$\log K_{K,Mg}^{Opt}$</td>
<td>-3.7</td>
</tr>
</tbody>
</table>

**Application 2 and Sensor Type**
Assay of K⁺ activity in aqueous pH buffered solutions with solvent polymeric fluorescent optode membranes based on Chromoionophore I (ETH 5294) and Potassium ionophore I. LEDs or diode lasers may be used as light sources.

**Recommended Membrane Composition**
- 2.98 wt% Chromoionophore I (27086)
- 13.43 wt% Potassium ionophore I (60403)
- 2.98 wt% Potassium tetrakis(4-chlorophenyl)borate (60591)
- 44.78 wt% Bis(2-ethylhexyl)sebacate (84818)
- 17.91 wt% WM-3 plasticizer
- 17.92 wt% Poly(vinyl chloride) high molecular weight (81392)
Recommended pH Buffer
0.1 M TRIS at pH 7.38

Optode Characteristics
Membrane range: 5 \times 10^{-6} to 10^{-1} \text{ K}^+
Membrane thickness: \sim 2 \mu m
Detection limit: \sim 5 \times 10^{-6} \text{ M K}^+
Response time: \sim 1 to 3 min

Application and Sensor Type
Assay of ammonia gas in aqueous solutions with solvent polymeric optode membranes based on Chromoionophore III (ETH 5350) and Potassium ionophore I. The optode membrane is covered with a gas-permeable membrane.

Recommended Membrane Composition

<table>
<thead>
<tr>
<th>wt%</th>
<th>Component</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.50</td>
<td>Potassium ionophore I (60403)</td>
<td></td>
</tr>
<tr>
<td>1.52</td>
<td>Chromoionophore III (27088)</td>
<td></td>
</tr>
<tr>
<td>1.52</td>
<td>Potassium tetrakis(4-chlorophenylphenyl)borate (60591)</td>
<td></td>
</tr>
<tr>
<td>62.31</td>
<td>Bis(2-ethylhexyl)sebacate (84818)</td>
<td></td>
</tr>
<tr>
<td>31.15</td>
<td>Poly(vinyl chloride) high molecular weight (81392)</td>
<td></td>
</tr>
</tbody>
</table>

Optode Characteristics
Selectivity coefficients \log K_{\text{NH}_3}^\text{Opt} as obtained by the separate solution method.

<table>
<thead>
<tr>
<th>Component</th>
<th>\log K_{\text{NH}_3,\text{MeNH}_2}^\text{Opt}</th>
<th>\log K_{\text{NH}_3,\text{MeN}}^\text{Opt}</th>
<th>\log K_{\text{NH}_3,\text{PrNH}_2}^\text{Opt}</th>
</tr>
</thead>
<tbody>
<tr>
<td>\text{PrNH}_2</td>
<td>-0.4</td>
<td>-2.0</td>
<td>-1.9</td>
</tr>
<tr>
<td>\text{MeNH}_2</td>
<td>-1.7</td>
<td>-2.9</td>
<td></td>
</tr>
<tr>
<td>\text{MeN}</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reproducibility:
10^{-4} \text{ NH}_3 \sim 3.2\%; 10^{-3} \text{ M NH}_3 \sim 1.6\%
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