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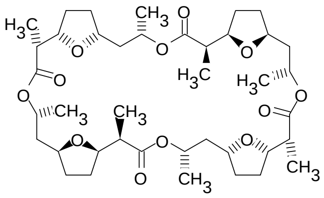
Ammonium



Ammonium ionophore I

(Nonactin*)

$C_{40}H_{64}O_{12}$ M_r 736.95 [6833-84-7]

09877 **Selectophore®, function tested** 50 mg, 250 mg

* purified and tested for the use in NH_4^+-selective electrodes

Ammonium ionophore I - Cocktail A

Ammonium-selective membrane solution for microelectrodes

09879 **Selectophore®** package with 0.1 mL

Ammonium ionophore I - Cocktail B

Ammonium-selective membrane solution for microelectrodes

09882 **Selectophore®** package with 0.1 mL

Ammonium ionophore I – Membrane A

09886 **Selectophore®** package with 5 PVC membranes
(diameter 7 mm)

Electrochemical Transduction

- Ion-Selective Electrodes
- Microelectrodes
- Microelectrodes
- Ion-Selective Field Effect Transistors (ISFET)

Optical Transduction

Miscellaneous Sensor Systems

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Electrochemical Transduction

Ion-Selective Electrodes

Application 1 and Sensor Type [1,2]

Assay of NH_4^+ activity in aqueous solutions with solvent polymeric electrodes based on Ammonium ionophore I.
Please note, this **Selectophore®** grade ionophore has been especially purified and tested for use in NH_4^+-selective electrodes.

Recommended Membrane Composition

1.00	wt%	Ammonium ionophore I (09877)
66.80	wt%	Bis(2-ethylhexyl) sebacate (DOS) (84818)[1)]
32.20	wt%	Poly(vinyl chloride) high molecular weight (81392)

1) The use of Bis(1-butylpentyl)decane-1,10-diyl diglutarate (30585) or Bis(1-butylpentyl)adipate (02150) leads to a membrane electrode of similar performance.

Recommended Cell Assembly

Reference | | sample solution | | ion-selective membrane | 0.1 M NH_4Cl | AgCl, Ag

Electrode Characteristics and Function

Selectivity coefficients $\log K^{Pot}_{NH_4,M}$ as obtained by the separate solution method (0.1 M solutions of the chlorides)

$\log K^{Pot}_{NH_4,H}$	-3.8	$\log K^{Pot}_{NH_4,K}$	-0.8
$\log K^{Pot}_{NH_4,Li}$	-3.6	$\log K^{Pot}_{NH_4,Mg}$	-5.5
$\log K^{Pot}_{NH_4,Na}$	-2.9	$\log K^{Pot}_{NH_4,Ca}$	-4.8

Nernstian electrode response with detection limit: $\log a_{NH_4} < -6$

Application 2 and Sensor Type [3]

Assay of NH_4^+ activity in aqueous solutions with solvent polymeric electrodes based on Ammonium ionophore I.

Recommended Membrane Composition

1.00	wt%	Ammonium ionophore I (09877)
33.00	wt%	Poly(vinyl chloride) high molecular weight (81392)
66.00	wt%	Dibutyl sebacate (84838)

Recommended Cell Assembly

Reference | | sample solution | | ion-selective membrane | 0.01 M NH_4Cl | Ag, AgCl

Electrode Characteristics and Function

Selectivity coefficients $\log K^{Pot}_{NH_4,M}$ as obtained by the separate solution method (0.1 M solutions of the chlorides)

$\log K^{Pot}_{NH_4,Li}$	-4.5	$\log K^{Pot}_{NH_4,Ca}$	-5.0
$\log K^{Pot}_{NH_4,Na}$	-2.9	$\log K^{Pot}_{NH_4,Me_4N}$	-3.7
$\log K^{Pot}_{NH_4,K}$	-0.9	$\log K^{Pot}_{NH_4,H}$	-5.0
$\log K^{Pot}_{NH_4,Mg}$	-2.9		

[1] M.S. Ghauri, J.D.R. Thomas, Evaluation of an ammonium ionophore for use in poly(vinyl chloride) membrane ion-selective electrodes: solvent mediator effects. **Analyst *119***, 2323 (1994)
[2] U. Thanei-Wyss, W.E. Morf, P. Lienemann, Z. Stefanac, I. Mostert, R. Dörig, R.E. Dohner, W. Simon, Determination of urea in 10-μl blood serum samples with a urease reactor / ion-selective electrode cell. **Mikrochim. Acta III**, 135 (1983).
[3] S.C. Ma, N.A. Chaniotakis, M.E. Meyerhoff, Response properties of ion-selective polymeric membrane electrodes prepared with aminated and carboxylated poly(vinyl chloride). **Anal. Chem. *60***, 2293 (1988).

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Slope of linear regression: 58.3 mV (10^{-4} to 10^{-1} M NH_4Cl in 0.01 M TRIS/HCl, pH 7.2)
Resistance: $0.98 \cdot 10^{8}\ \Omega$
Lifetime: log P_{TLC}[1)] ionophore : 5.8

[1)] lipophilicity, determined by thin layer chromatography [4]

Application 3 and Sensor Type [5]
Assay of NH_4^+ activity in aqueous solutions with solvent polymeric electrodes based on Ammonium ionophore I. This membrane composition does not require the use of a buffer trap as in other plasticizer systems.

Recommended Membrane Composition

0.20	wt%	Ammonium ionophore I (09877)
69.00	wt	2-Nitrophenyl octyl ether (73732)
30.80	wt%	Poly(vinyl chloride) high molecular weight (81392)

Recommended Cell Assembly
Reference | | sample solution | | liquid membrane | 0.01 M NH_4Cl | AgCl,Ag

Electrode Characteristics and Function

Selectivity Coefficients $\log K^{Pot}_{NH_4,M}$ as obtained by the separate solution method (0.1 M solutions of the chlorides).

$\log K^{Pot}_{NH_4,Li}$	-2.9	$\log K^{Pot}_{NH_4,Ca}$	-3.2
$\log K^{Pot}_{NH_4,Na}$	-2.6	$\log K^{Pot}_{NH_4,Mg}$	-3.8
$\log K^{Pot}_{NH_4,K}$	-1.6		

Slope of linear regression: 59 mV at 25°C (10^{-5} to $5 \cdot 10^{-1}$ M NH_4Cl)
Detection limit: 5·10-6 M NH_4^+
Practical pH measuring range: <9
Membrane resistance: 1.33 MΩ (membrane thickness 0.47 mm)

[4] O. Dinten, U.E. Spichiger, N. Chaniotakis, P. Gehrig, B. Rusterholz, W.E. Morf, W. Simon, Lifetime of neutral-carrier-based liquid membranes in aqueous samples and blood and the lipophilicity of membrane components, **Anal. Chem. *63*,** 596 (1991).
[5] M.S. Ghauri, J.D.R. Thomas, Poly(vinyl chloride) type ammonium ion- selective electrodes based on nonactin : solvent mediator effects. **Anal. Proc. *31***, 181 (1994).

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Microelectrodes

Application 1 and Sensor Type [6,7,8]
Assay of NH_4^+ activity with microelectrodes based on Ammonium ionophore I.

Ammonium ionophore I - Cocktail A (09879)

Cocktail Composition:

6.90	w%	Ammonium ionophore I (09877)
0.70	wt%	Potassium tetrakis(4-chlorophenyl)borate (60591)
92.40	wt	2-Nitrophenyl octyl ether (73732)

Recommended Cell Assembly
Reference | | sample solution | | cocktail | 0.01 M NH_4NO_3 | AgCl,Ag

Electrode Characteristics and Function

Selectivity Coefficients $\log K^{Pot}_{NH_4,M}$ as obtained by the separate solution method (0.1 M solutions of the chlorides).

$\log K^{Pot}_{NH_4,H}$	-2.2	$\log K^{Pot}_{NH_4,K}$	-0.6
$\log K^{Pot}_{NH_4,Li}$	-3.6	$\log K^{Pot}_{NH_4,Ca}$	-4.4
$\log K^{Pot}_{NH_4,Na}$	-2.0	$\log K^{Pot}_{NH_4,Mg}$	-4.2

Slope of linear regression: 54.5 mV (10^{-4} to 10^{-1} M NH_4Cl)
Detection limit (NH_4Cl, no ion background): log a_{NH4} ~-5.8
Electrical resistance, tip diameter ~1 µm, filling height 200 to 300 µm: ~$6 \cdot 10^{10}$ Ω
Response time: 90% response time 1 to 2 s

Application 2 and Sensor Type [9]
Assay of NH_4^+ activity with microelectrodes based on Ammonium ionophore I. This cocktail shows an improved selectivity over K^+..

Ammonium ionophore I - Cocktail B (09882)

Cocktail Composition

3.50	w%	Ammonium ionophore I (09877)
0.35	wt%	Potassium tetrakis(4-chlorophenyl)borate (60591)
0.90	wt%	Poly(vinyl chloride) high molecular weight (81392)
32.95	wt%	Dibutyl sebacate (84838)
62.30	wt%	Tetrahydrofuran (87369)

Recommended Cell Assembly
Reference | sample solution | | cocktail | 0.5 M NH_4Cl | AgCl, Ag

[6] T. Bührer, H. Peter, W. Simon, NH_4^+ ion-selective microelectrode based on the antibiotics nonactin/monactin. **Pflügers Arch.** ***412***, 359 (1988).
[7] D. De Beer, J.C. van den Heuvel, Response of ammonium-selective microelectrodes based on the neutral carrier nonactin. **Talanta** ***35***, 728 (1988).
[8] F. Fresser, H. Moser, M. Nair, Intra- and Extracellular Use and Evaluation of Ammonium-Selective Microelectrodes. **J. Exp. Biol.** ***157***, 227 (1991).
[9] G.H. Henriksen, A.J. Bloom, R.M. Spanswick, Measurement of Net Fluxes of Ammonium and Nitrate at the Surface of Barley Roots Using Ion-Selective Microelectrodes. **Plant. Physiol.** ***93***, 271 (1990).

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Electrode Characteristics and Function

Selectivity Coefficients $\log K^{Pot}_{NH_4,M}$ as obtained by the fixed interference method.

$\log K^{Pot}_{NH_4,K}$	-1.0
$\log K^{Pot}_{NH_4,Na}$	-2.7

Slope of linear regression: 57.6 ± 1.1 mV (10^{-4} to 10^{-3} M NH_4NO_3); ion background concentration for interfering ions: 3.13 mM Na^+ and 0.002M K^+.
Detection limit: 1 µmol NH_4NO_3
Stability: Drift ~1.4 ± 0.9 mV/10 min (n=6)
Response time : 90% response time: <10 s

Ion-Selective Field Effect Transistors (ISFET)

Application and Sensor Type [10]
Assay of NH_4^+ activity with silicon rubber matrix ion-selective field effect transistors based on Ammonium ionophore I.

Recommended Membrane composition

2.00	w%	Ammonium ionophore I (09877)
0.54	wt%	Potassium tetrakis(4-chlorophenyl)borate (60591)
88.60	wt%	Siloprene K 1000 (85417)
8.86	wt%	Siloprene crosslinking agent K 11 (85418)

Electroanalytical Characteristics

Selectivity Coefficients $\log K^{Pot}_{NH_4,M}$ as obtained by the fixed interference solution method (0.001 M solutions of the chlorides).

$\log K^{Pot}_{NH_4,K}$	-1.2
$\log K^{Pot}_{NH_4,Na}$	-2.1

Slope of linear regression: 56 mV (10^{-5} to 10^{-2} M NH_4NO_3)
Drift: <0.5 mV/h (after 24 h preconditioning)

[10] S. Ufer, K. Cammann, Ion-sensitive field-effect transistor with improved membrane adhesion. **Sensors and Actuators 7**, 572 (1992).

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Optical Transduction

***Application 1 and Sensor Type*[11]**
Assay of NH_4^+ activity in aqueous pH-buffered solutions with polymeric optode membranes based on Ammonium ionophore I and Chromoionophore III (ETH 5350).

Recommended Membrane Composition

2.00	wt%	Ammonium ionophore I (09877)
1.30	wt%	Potassium tetrakis(4-chlorophenyl)borate (60591)
1.00	wt%	Chromoionophore III (27088)
67.50	wt%	Bis(2-ethylhexyl)sebacate (84818)
15.00	wt%	Poly(vinyl chloride) high molecular weight (81392)
15.00	wt%	Polyurethane (81367)

Recommended pH Buffer
0.16 M sodium acetate, adjusted with acetic acid to pH 5.3 for recording the calibration curve.

Optode Characteristics and Function

Selectivity Coefficients $\log K^{Opt}_{NH_4,M}$ as obtained by the separate solution method in pH-buffered solutions.

$\log K^{Opt}_{NH_4,Na}$	-3.6	$\log K^{Opt}_{Ca,Mg}$	-4.1
$\log K^{Opt}_{Ca,K}$	-3.8		

***Application 2 and Sensor Type*[12]**
Assay of NH_4^+ activity in aqueous pH-buffered solutions with polymeric optode membranes based on Ammonium ionophore I and Chromoionophore I (ETH 5294).

Recommended Membrane Composition

1.58	wt%	Chromoionophore I (27086)
2.36	wt%	Ammonium ionophore I (09877)
1.54	wt%	Potassium tetrakis(4-chlorophenyl)borate (60591)
63.02	wt%	Bis(2-ethylhexyl)sebacate (84818)
31.50	wt%	Poly(vinyl chloride) high molecular weight (81392)

Optode Characteristics and Function

Selectivity Coefficients $\log K^{Opt}_{NH_4,M}$ [13].

$\log K^{Opt}_{NH_4,K}$	-1.2	$\log K^{Opt}_{NH_4,Li}$	-3.4
$\log K^{Opt}_{NH_4,Na}$	-2.7		

Dynamic range: 10^{-2} to 10^{-5} M NH_4^+ at pH 7.35
Response time: 95% response time 5 s (membrane thickness 4 µm)

[11] E. Wang, M.E. Meyerhoff, Evaluation of Polyurethane-Based Membrane Matrices for Optical Ion-Selective Sensors. **Anal. Lett.** ***26***, 1519 (1993).
[12] K. Seiler, W.E. Morf, B. Rusterholz, W. Simon, Design and Characterization of a Novel Ammonium Ion Selective Optical Sensor Based on Neutral Ionophores. **Anal. Sci.** ***5***, 557 (1989).
[13] Fluka H58166H: K. Seiler, Ion-selective Optode Membranes, monograph, describing theory, preparation and application of ion-selective optode membranes as well as recent developments in this field. With 237 references. published by Fluka Chemie GmbH, Buchs, Switzerland (1993).
Fluka H58165H: K. Seiler, Ionenselektive Optodenmembranen, dt. Monographie, herausgegeben von Fluka Chemie GmbH, Buchs, Switzerland (1993).

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Miscellaneous Sensor Systems

Application and Sensor Type[14]
Assay of NH_4^+ activity with silicon microsensor chips based on Ammonium ionophore I silicon matrix membranes.

Recommended Membrane Composition

2.10	wt%	Ammonium ionophore I (09877)
0.80	wt%	Potassium tetrakis(4-chlorophenyl)borate (60591)
28.00	wt%	Bis(2-ethylhexyl)sebacate (84818)
69.10	wt%	Fluorosilicone 730 Dow Corning

Electroanalytical Characteristics

Selectivity Coefficients $\log K^{Pot}_{NH_4,M}$ as obtained by the fixed interference method (0.01 M Na^+; 0.001 M K^+).

$\log K^{Pot}_{NH_4,Na}$	-3.1
$\log K^{Pot}_{NH_4,K}$	-0.8

Slope of linear regression: 54 mV ($4 \cdot 10^{-5}$ to $5 \cdot 10^{-2}$ M NH_4NO_3)
Lifetime: >7d

[14] M. Knoll, K. Cammann, C. Dumschat, C. Sundermeier, J. Eschold, Potentiometric silicon microsensor for nitrate and ammonium, **Sens. Actuators *B18-19***, 51 (1994).