

德国 FuMATech 公司

FuMATech (FUMATECHBWTGmbH) 公司位于德国，是一家主要从事燃料电池技术和膜分离技术领域，特别是水溶液处理的高科技公司。FuMATech 公司的 DynamicTeam 受益于其高素质人员，在聚合物化学、膜生产和膜分离技术方面拥有 25 年以上经验。

FuMA-Tech公司离子交换膜使用领域包括：低温质子交换膜燃料电池 (LT-PEMFC)、高温质子交换膜燃料电池 (HT-PEMFC)、直接甲醇燃料电池



(DMFC)、碱性燃料电池 (AFC)、氧还原液流电池、电解槽和电渗析等。

FuMA-Tech 公司的产品丰富，包含有：阴离子交换膜 (AEM)、阳离子交换膜 (CEM/PEM) 双极膜 (BPM)；包含多个系列产品，其中 Fumion 系列为离聚体树脂，主要作为分散剂和粘合剂；Fumasep 系列主要用于电渗析和液流电池；Fumapem 主要用于燃料电池，包括 AFC、PEMFC、DMFC 等，Fumea 系列主要是水电解用催化剂涂层膜。

Fumasep 系列离子膜主要用于电渗析和液流电池，以标准板材尺寸提供，最大宽度为 1650mm，根据应用场景的不同，有标准等级膜、双极膜和电渗析膜、特殊等级膜等不同分类。

1. Fumapem系列阳离子膜

Fumapem-F-930、Fumapem-F-930-RFS、Fumapem-FS-930-RFS、Fumapem-F-950、Fumapem-F-14100 这五款阳离子膜是 Fumapem 系列的阳离子膜。

1.1 Fumapem-F-930阳离子膜

fumapem®		F-930
membrane type		cation exchange membrane
appearance / colour		transparent, colourless
backing foil		PET foil
reinforcement		none
counter ion		H-form
delivery form		dry (non-activated)
thickness (dry, as received)	µm	28-33
thickness (wet)	µm	30-37
weight per unit area	mg cm ⁻²	9.5 – 9.6
IEC (ion exchange capacity)	meq g ⁻¹	0.95
area resistance in H ₂ O at T = 25 °C in H-form ^{a)}	Ω cm ²	0.25
conductivity in H ₂ O at T = 25 °C in H-form ^{a)}	mS cm ⁻¹	11.3
selectivity 0.1 / 0.5 mol/kg KCl at T = 25 °C ^{b)}	%	> 90%
uptake in H ₂ O at T = 25 °C in H-form ^{c)}	wt %	23
dimensional swelling in H ₂ O at T = 25 °C in H-form ^{d)}	%	12 – 14
proton transfer rate ^{e)}	µmol min ⁻¹ cm ²	> 10.000
Young's modulus at 23 °C / 50 % r.h. ^{f)}	MPa	200 – 250
yield strength at 23 °C / 50 % r.h. ^{f)}	MPa	10 – 15
tensile strength at 23 °C / 50 % r.h. ^{f)}	MPa	20 – 30
elongation at break at 23 °C / 50 % r.h. ^{f)}	%	125 – 160
bubble point test in water at T = 25 °C	bar	> 2

a) measured in 4-electrode cell (in-plane), sample activated in 10 % H₂SO₄, T = 100 °C for 30 min.

b) determined from membrane potential measurement in a concentration cell, sample activated in 10 % H₂SO₄, T = 100 °C for 30 min.

c) reference membrane dried over P₂O₅ *in vacuo*, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min.

d) reference membrane dried at ambient conditions (25 °C, 50 % r.h.), sample activated in 10 % H₂SO₄, T = 100 °C, 30 min.

e) determined from pH potential measurement in a concentration cell 0.5 M HCl / 0.5 M NaCl @ T = 25 °C, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min.

f) determined by stress-strain measurement at T = 25 °C and 50 % r.h., according to DIN EN 527-1, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min.

1.2 Fumapem-F-930-RFS 阳离子膜

fumapem®		F-930-RFS
membrane type		cation exchange membrane
appearance		transparent / colorless
backing foil		PET
reinforcement		yes
counter ion		H-form
delivery form		dry
thickness (dry)	µm	28 - 33
IEC (ion exchange capacity)	meq g ⁻¹	0.89-1.02
area resistance in H ₂ O at T = 25 °C in H-form ^{a)}	Ω cm ²	< 0.15
conductivity in H ₂ O at T = 25 °C in H-form ^{a)}	mS cm ⁻¹	110
area resistance at 80 °C and 100 % rel. humid. ^{b)}	Ω cm ²	< 0.12
area resistance at 80 °C and 50 % rel. humid. ^{b)}	Ω cm ²	< 0,17
uptake in H ₂ O at T = 25 °C in H-form ^{c)}	wt %	15
dimensional swelling in H ₂ O at T = 25 °C in H-form ^{d)}	%	3
Young's modulus at 23 °C / 50 % r.h. ^{e)}	MPa	> 230
yield strength at 23 °C / 50 % r.h. ^{e)}	MPa	> 10
tensile strength at 23 °C / 50 % r.h. ^{e)}	MPa	> 20
elongation at break at 23 °C / 50 % r.h. ^{d)}	%	> 150

a) measured in two-electrode cell (through-plane), sample activated in 10 % H₂SO₄, T = 80 °C, 24 hrs before measurement.

b) determined from EIS during fuel cell operation

c) reference membrane dried over P₂O₅ *in vacuo*, sample activated in 10 % H₂SO₄, T = 80 °C, 24 hrs before measurement.

d) reference membrane dried at ambient conditions (25 °C, 50 % r.h.), sample activated in 10 % H₂SO₄, T = 80 °C, 24 hrs before measurement.

e) determined by stress-strain measurement at T = 25 °C and 50 % r.h., according to DIN EN 527-1.

1.3 Fumapem-FS-930-RFS 阳离子膜

fumapem®		FS-930-RFS
membrane type		cation exchange membrane
appearance		transparent / colourless
backing foil		PET
reinforcement		yes
counter ion		H-form
delivery form		dry
thickness (dry)	µm	27-32
IEC (ion exchange capacity)	meq g ⁻¹	1.15
area resistance in H ₂ O at T = 25 °C in H-form ^{a)}	Ω cm ²	< 0.02
conductivity in H ₂ O at T = 25 °C in H-form ^{a)}	mS cm ⁻¹	> 120
area resistance at 80 °C and 100 % rel. humid. ^{b)}	Ω cm ²	< 0,08
area resistance at 80 °C and 50 % rel. humid. ^{b)}	Ω cm ²	< 0,14
uptake in H ₂ O at T = 25 °C in H-form ^{c)}	wt %	17
dimensional swelling in H ₂ O at T = 25 °C in H-form ^{d)}	%	10
Young's modulus at 23 °C / 50 % r.h. ^{e)}	MPa	> 250
yield strength at 23 °C / 50 % r.h. ^{e)}	MPa	> 10
tensile strength at 23 °C / 50 % r.h. ^{e)}	MPa	> 20
elongation at break at 23 °C / 50 % r.h. ^{d)}	%	> 150

- a) measured in two-electrode cell (through-plane), sample activated in 10 % H₂SO₄, T = 80 °C, 24 hrs before measurement.
b) determined from EIS during fuel cell operation
c) reference membrane dried over P₂O₅ *in vacuo*, sample activated in 10 % H₂SO₄, T = 80 °C, 24 hrs before measurement.
d) reference membrane dried at ambient conditions (25 °C, 50 % r.h.), sample activated in 10 % H₂SO₄, T = 80 °C, 24 hrs before measurement.
e) determined by stress-strain measurement at T = 25 °C and 50 % r.h., according to DIN EN 527-1.

1.4 Fumapem-F-950 阳离子膜

fumapem®		F-950
membrane type		cation exchange membrane
appearance / colour		transparent, colourless
backing foil		PET foil
reinforcement		none
counter ion		H-form
delivery form		dry (non-activated)
thickness (dry, as received)	µm	44 – 49
thickness (wet)	µm	47 – 55
weight per unit area	mg cm ⁻²	9.5 – 9.6
IEC (ion exchange capacity)	meq g ⁻¹	0.95
area resistance in H ₂ O at T = 25 °C in H-form ^{a)}	Ω cm ²	0.44
conductivity in H ₂ O at T = 25 °C in H-form ^{a)}	mS cm ⁻¹	11.3
selectivity 0.1 / 0.5 mol/kg KCl at T = 25 °C ^{b)}	%	93 – 94
uptake in H ₂ O at T = 25 °C in H-form ^{c)}	wt %	23
dimensional swelling in H ₂ O at T = 25 °C in H-form ^{d)}	%	12 – 14
proton transfer rate ^{e)}	µmol min ⁻¹ cm ⁻²	> 10.000
Young's modulus at 23 °C / 50 % r.h. ^{f)}	MPa	500 – 550
yield strength at 23 °C / 50 % r.h. ^{f)}	MPa	13 – 17
tensile strength at 23 °C / 50 % r.h. ^{f)}	MPa	30 – 35
elongation at break at 23 °C / 50 % r.h. ^{f)}	%	125 – 160
bubble point test in water at T = 25 °C	bar	> 3

- a) measured in 4-electrode cell (in-plane), sample activated in 10 % H₂SO₄, T = 100 °C for 30 min.
b) determined from membrane potential measurement in a concentration cell, sample activated in 10 % H₂SO₄, T = 100 °C for 30 min.
c) reference membrane dried over P₂O₅ *in vacuo*, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min.
d) reference membrane dried at ambient conditions (25 °C, 50 % r.h.), sample activated in 10 % H₂SO₄, T = 100 °C, 30 min.
e) determined from pH potential measurement in a concentration cell 0.5 M HCl / 0.5 M NaCl @ T = 25 °C, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min.
f) determined by stress-strain measurement at T = 25 °C and 50 % r.h., according to DIN EN 527-1, sample activated in 10 % H₂SO₄, T = 100 °C, 30 min.

1.5 Fumapem-F-14100 阳离子膜

fumapem®		F-14100
membrane type		cation exchange membrane
appearance / colour		transparent, colourless
backing foil		PET foil
reinforcement		none
counter ion		H-form
delivery form		dry
thickness (dry)	µm	100 – 120
IEC (ion exchange capacity)	meq g ⁻¹	0.6 – 0.8
area resistance in H ₂ O at T = 25 °C in H-form ^{a)}	Ω cm ²	0.2 – 0.3
conductivity in H ₂ O at T = 25 °C in H-form ^{a)}	mS cm ⁻¹	60 – 70
selectivity 0.1 / 0.5 mol/kg KCl at T = 25 °C ^{b)}	%	> 96
uptake in H ₂ O at T = 25 °C in H-form ^{c)}	wt %	15 - 25
dimensional swelling in H ₂ O at T = 25 °C in H-form ^{d)}	%	4 – 6
Young's modulus at 23 °C / 50 % r.h. ^{e)}	MPa	250 – 400
yield strength at 23 °C / 50 % r.h. ^{e)}	MPa	10 – 20
tensile strength at 23 °C / 50 % r.h. ^{e)}	MPa	20 – 40
elongation at break at 23 °C / 50 % r.h. ^{d)}	%	> 300
bubble point test in water at T = 25 °C	bar	> 4
pH stability range	pH	0 - 10

a) measured in two-electrode cell (through-plane), sample activated in 10 % H₂SO₄, T = 80 °C, 24 hrs.

b) determined from membrane potential measurement in a concentration cell.

c) reference membrane dried over P₂O₅ *in vacuo*, sample activated in 10 % H₂SO₄, T = 80 °C, 24 hrs before measurement.

d) reference membrane dried at ambient conditions (25 °C, 50 % r.h.), sample activated in 10 % H₂SO₄, T = 80 °C, 24 hrs before measurement.

e) determined by stress-strain measurement at T = 25°C and 50 % r.h., according to DIN EN 527-1, sample activated in 10 % H₂SO₄, T = 80 °C, 24 hrs before measurement.