



High Performance Perfluorosulfonic Acid Membranes

fumion[®]F ionomers and fumapem[®]F membranes

www.fumatech.de



fumatech
functional membranes for fuel cells

 **BWT** GROUP

Polymer and Membrane Engineering with Responsibility: The most durable and most reliable materials for electro-membrane applications ... as versatile as the demands they have to fulfil!

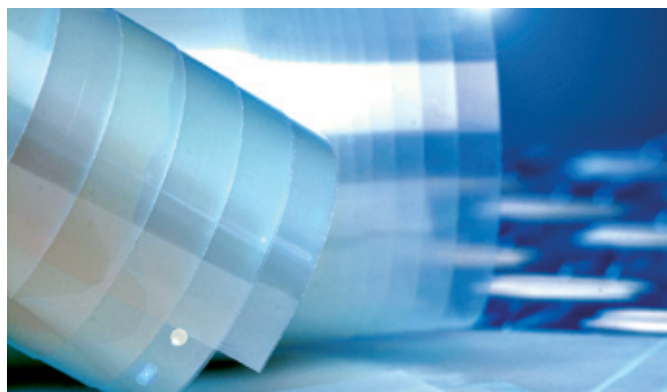
fumion® F ionomers

fumion® F ionomers are manufactured from a perfluorinated sulfonic acid copolymer and are available in a wide variety of compositions and forms. The polymers are chemically very stable and durable. **fumion® F** ionomers in SO₃H-form perform as a cation exchanger and are widely used for various electrochemical applications such as fuel cells, batteries and electrolysis.

Standard **fumion® F** resin in SO₃H-form is supplied as granules, instant powders and in dispersions of several compositions with an equivalent weight ranging from 900 to 1050 g/eq. In addition, FuMA-Tech provides **fumion® FF** perfluorosulfonyl fluoride resin in SO₂F-form for melt processing and film extrusion.

fumion® F polymer data

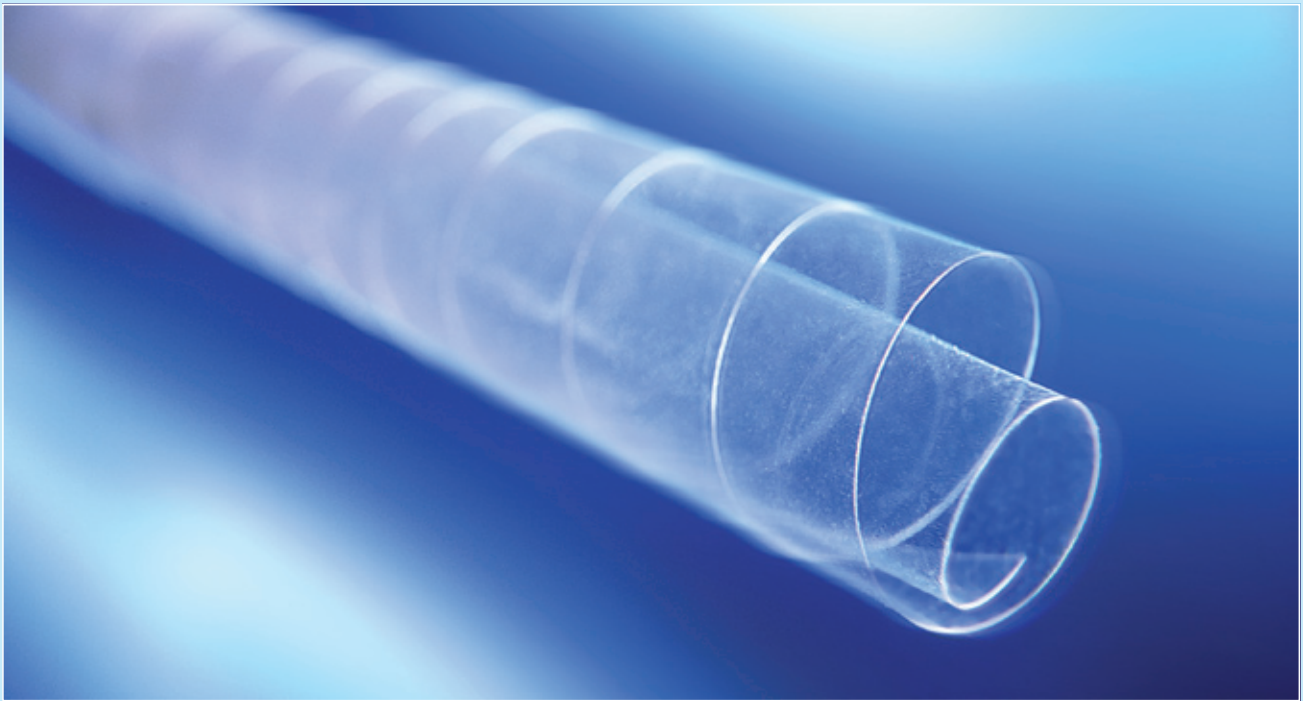
	fumion® F
type	PFSA (-SO ₂ F or -SO ₃ H form)
EW	900 - 1050
polydispersity	<2.0
solvent	H ₂ O, NPA / H ₂ O
Density	1.98 - 2.0 g/cm ³



fumion® F Instant powder is supplied in SO₃H-form and is extremely hydrophilic. It can be easily redissolved in many polar solvents such as n-propanol (NPA), n-propanol/water and so on.

fumion® FL dispersions are commonly used for the fabrication of films, coating and ink formulations in the field of fuel cells and SPE electrolyzers. Thin coatings can easily be prepared via spray or spin coating, screen-printing or solution casting followed by a simple drying process. Standard polymer content of **fumion® FL** dispersions is 10 wt % in water and aqueous n-propanol. Other compositions of **fumion® FL** dispersions are available upon request.





fumapem® F membranes

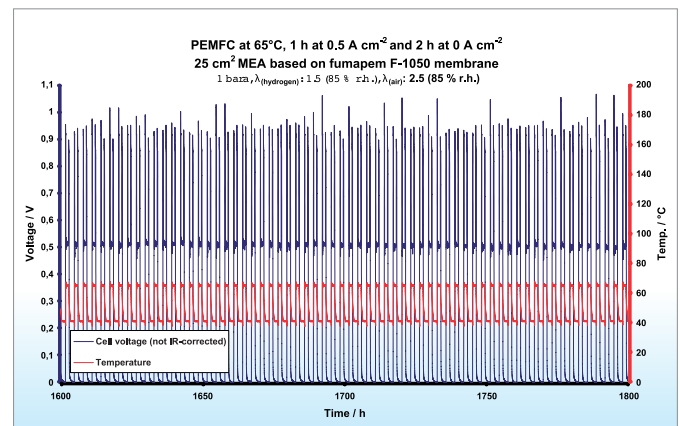
FuMA-Tech offers perfluorosulfonic acid membranes for PEMFC, DMFC, batteries and electrolysis applications. **fumapem® F** membranes are produced from **fumion® F** ionomers and are available in different equivalent weights and thicknesses. These chemically stabilised high-performance materials are approved in terms of mechanical and electrochemical properties, reliability and durability.

fumapem® F membranes are produced according to FuMA-Tech's proprietary solution casting technology. They are supplied in standard sheet sizes of 200 x 300 mm, 500 x 1000 mm and on rolls of 500 mm maximum width with thicknesses ranging from 0.02 mm to 0.20 mm.

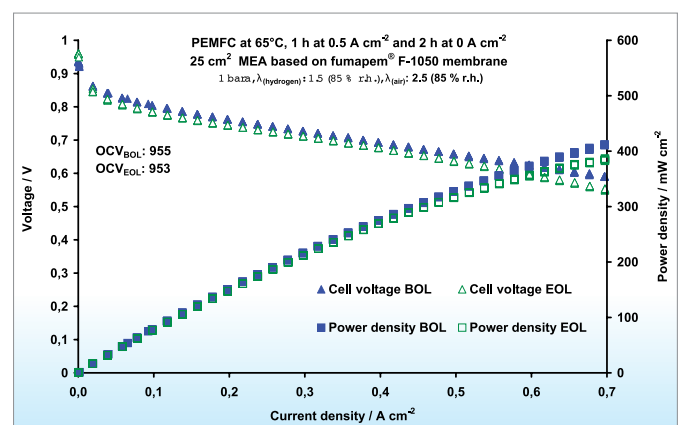
The **fumapem® F** films with **0.02 mm to 0.10 mm** thickness are used as proton exchange membrane for low temperature fuel cell applications such as polymer electrolyte fuel cell and direct methanol fuel cell. The thin film is supported by a release foil of high mechanical strength for further processing. Mechanically reinforced membranes are available as well.

The **fumapem® F** films with **0.10 mm to 0.20 mm** thickness are used as cation exchange membranes for standard electrolysis applications such as water electrolysis for hydrogen/oxygen and disinfectant production, and any type of electrolysis where an oxidising stable membrane is required. The thick films are available with mechanically reinforced woven and as plain film as well.

Cycling curve of LT-PEM fumea®



Polarisation curves of LT-PEM fumea®



fumapem® F membrane data

		fumapem® F-930	fumapem® F-1050	fumapem® F-930 rf [†]	fumapem® F-10120	fumapem® F-10180 rf
EW	g/eq	900	1000	900	1000	1000
conductivity in H-form ^{a)}	mS/cm	>100	>90	>100	>80	>50
area resistance in H-form ^{a)}	Ω cm ²	<0,030	<0,055	<0,030	<0,150	<0.50
thickness (dry)	mm	0,03	0,05	0,03	0,12	0.18
reinforcement	-	-	-	ePTFE	-	PTFE
water uptake ^{a)}	wt %	~35	~31	~30	~48	~27
dimensional swelling ^{a, b)}	%	~18	~15	~10	~20	~10
elongation at break, 50 % r.h., 23°C ^{c)}	%	>230	>200	>220	>260	>55
tensile modulus, 50 % r.h., 23°C ^{c)}	MPa	>190	>180	>330	>230	>280
tensile strength, maximum, 50 % r.h., 23°C ^{c)}	MPa	>22	>23	>30	>16	>50
glass transition temperature ^{d)}	°C	100 - 110	110 - 120	100 - 110	110 - 120	110 - 120
start of thermal decomposition ^{e)}	°C	270 - 300	270 - 300	270 - 300	270 - 300	270 - 300

a) determined in H₂O at T = 25°C

b) reference membrane dried at room temperature and 50 % r.h.

c) according to DIN EN ISO 527-1

d) determined in dry state using DMA

e) determined using TGA

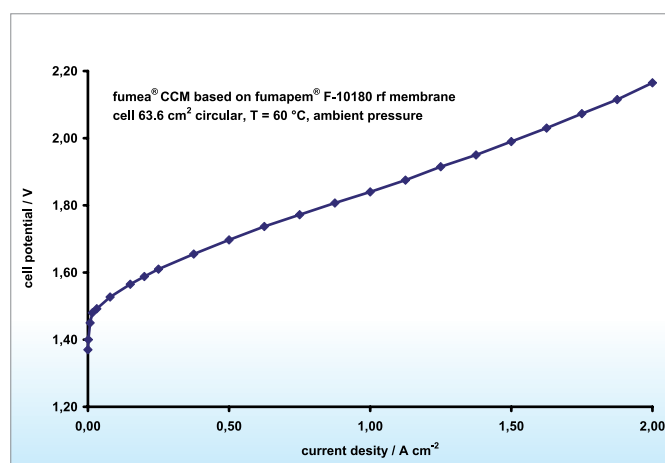
Key features

- **fumapem F-930** for portable fuel cell applications
- **fumapem F-930 rf** for mobile and automotive fuel cell applications
- **fumapem F-1050** for stationary fuel cell systems
- **fumapem F-10120** for DMFC applications
- **fumapem F-10180 rf** for water electrolysis applications

fumea® CCM for water electrolysis

- **The fumea® CCM (catalyst coated membrane)** for water electrolysis is designed for various pressure applications. For small scale lab-application with low pressure difference (up to 10 bar), fumea® CCM based on fumapem® F-10180 rf membrane is a perfect solution for its high performance.
- **The fumea® CCM** can be made in various size and profiles from few square centimetres up to size as large as 1000 sqcm. Thanks to reduced loading of precious metals, the fumea® CCM offers good economical trade-off in recent trends of hydrogen production.
- **Ion-exchange** resins as ion-exchange cartridges made by FuMA-Tech are also available for sustainable supply of clean water.

Polarisation curve of fumea® CCM for water electrolysis





The company

Focussing on water as the basis of all forms of life, and energy as the basis for a higher quality of life, FuMA-Tech “Functional Membranes and Plant Technology” combines the important tasks of providing energy and water. The company is engaged in the field of fuel cell technology and membrane separation technology, particularly for the treatment of aqueous solutions.

FuMA-Tech draws its particular strengths as a leading producer of ion-exchange membranes from its membership in the BWT Best Water Technology - Group.

FuMA-Tech is committed to develop new products that will accelerate progress in polymer electrolyte fuel cells.

The company is both competent and competitive as a leading supplier of polymers and membranes for manufacturing of membrane electrode assemblies.

The high performance membranes are the heart of a proton exchange membrane (PEM) fuel cell stack.

FuMA-Tech produces and develops

- polyelectrolytes (**fumion**[®] ionomers),
 - proton conductive membranes (**fumapem**[®] membranes) and
 - separation membranes (**fumasep**[®] membranes)
- based on proprietary technology and designed for high precision mass manufacturing.

fumion [®]	ionomer resin as granular polymer, in solution form or in dispersion
fumion [®] FF	granular perfluorosulfonyl fluoride resin for extrusion
fumapem [®] F	perfluorosulfonic acid membranes for PEMFC
fumapem [®] AM	polybenzimidazole membranes for high temperature PEMFC
fumapem [®] ST	hydrocarbon membranes for DMFC and PEMFC
fumapem [®] P,E	hydrocarbon membranes for DMFC
fumapem [®] FAA	anion-exchange membrane for alkaline FC
fumasep [®] FAP	anion-exchange membrane for redox flow batteries
fumasep [®] FBM	bipolar membrane
fumasep [®] HF	hollow fibre cartridge for gas humidification
fumasep [®]	ion-exchange membranes for humidifier, electro dialysis and electrolysis
fumea [®]	catalyst coated membranes for water electrolysis

BWT – The Water Company

The Best Water Technology Group was formed in 1990 and today is Europe's leading water technology company. The goal of our 2,700 employees in 80 subsidiaries and associates is to provide private, industrial, business, hotel, hospital and municipal customers with innovative, ecological and efficient technologies that deliver maximum safety, hygiene and health in their daily contact with the elixir of life, water.

BWT offers state-of-the-art water treatment technologies and services for drinking water, pharma water, process water, heating water, boiler water, cooling water and water for air-conditioning systems as well as swimming pool water. For the technological superiority in all areas of water treatment, the international BWT innovation centers continuously research, develop and optimize processes for filtration, filter media, ion exchange systems for demineralization, softening, decarbonisation, membrane technologies (microfiltration, ultrafiltration, nanofiltration, reverse osmosis), pure steam generators, high purity water distills UV systems, ozone generators, ion exchange membranes, electrolysis systems, electro dialysis, electrodeionisation, chlorine dioxide generators and metering pumps which are used throughout the world to achieve excellent water quality.

Tens of thousands of service employees, plumbers, planners, architects and sanitation experts constitute the BWT water partner network. Whether at the entrance of the water pipe into a building (at the "Point of Entry") or at the tapping point ("Point

of Use"), BWT products "made in Europe" have proven their quality million times. With new table water filters for preparing tea or coffee, filters for optimizing water for coffee machines, water filters for baking and steam ovens and vending machines, under-the-sink particle-filters as well as micro-filters, water dispensers, reverse osmosis and UV devices BWT also offers compact and innovative products for end consumers for best water quality.

With unique high efficiency membranes for fuel cells and batteries BWT is working for a cleaner energy supply of the 21st century.

Employees in Research & Development work on new processes and materials using state-of-the-art methodologies targeting to develop ecological, at the same time efficient products. The reduction of energy consumption of products and minimization of CO₂-emissions forms a key issue for new and further development. Ecological, economical and social responsibility and the employment of state-of-the-art technologies as well as permanent product evolution contribute significantly to growing the company and the reputation of the market-leading regional brands BWT, HOH, Permo and Christ Aqua as well as Christ Aqua Pharma & Biotech.

BWT – The Water Company - is our vision to provide our customers and partners with the best products, systems and technologies and services in all areas of water treatment.

BWT – The Leading International Water Technology Group.

For further information:

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