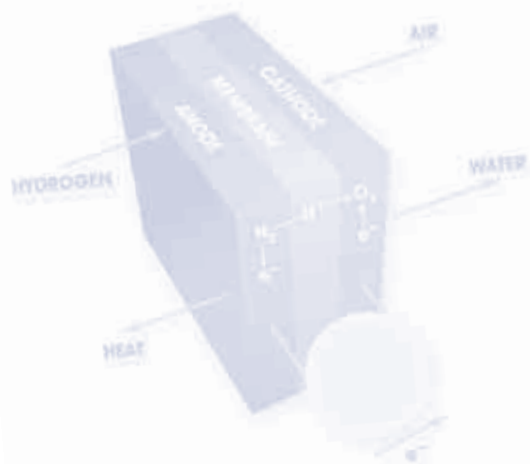


Fuel Cells

Catalysts & Components

The Power Behind the Progress



Fuel Cell Components

HiSPEC™ Fuel Cell Catalysts

HiFUEL™ Fuel Processing Catalysts

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INTRODUCTION

Johnson Matthey has dedicated many years to developing fuel cell technology and continues to make significant investments in its fuel cell business. Consequently, Johnson Matthey Fuel Cells (JMFC) is a world leader in the design and fabrication of catalysts, catalytic components and subsystems for fuel cell applications. With a foundation of more than 50 years in research, development and manufacturing, our focus is on low temperature fuel cell components, notably Proton Exchange Membrane fuel cells (PEMFC) and Direct Methanol Fuel Cells (DMFC).

JMFC's HISPEC™ catalysts consist of single and bimetallic, highly dispersed supported and unsupported catalysts used on anodes and cathodes in PEMFC and DMFC. HISPEC catalysts are highly active and are designed and manufactured to the highest quality standards for maximum performance and durability. Products are available in several precious metal loadings and on a range of carbon supports. Large production volumes are commercially available.

Alfa Aesar is proud to introduce a new line of HiFUEL™ base metal fuel processing catalysts, which complements the HISPEC catalyst products. A selection of Membrane Electrode Assemblies (MEAs) and other fuel cell components are also available.

FUEL CELL COMPONENTS PRODUCTS INCLUDE:

- Nafion® membranes
- Toray™ Carbon Paper
- Cathodes and anodes for Hydrogen, DMFC and Reformate fuel cells
- MEAs for Hydrogen, DMFC and Reformate fuel cells

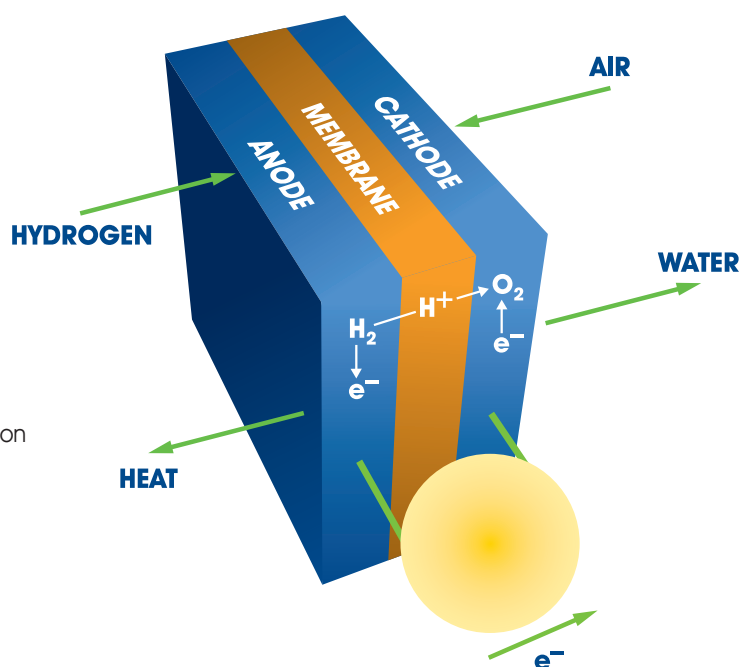
HISPEC™ PRODUCTS INCLUDE:

- Pt black and Pt/Ru black (non-supported)
- Pt and Pt/Ru on standard carbon support
- Pt and Pt/Ru on high surface area carbon support

HiFUEL™ FUEL PROCESSING CATALYST PRODUCTS INCLUDE:

- Base metal catalysts for reforming, water gas shift and purification
- A complementary range of HiFUEL precious metal catalysts supplied on tailored supports is also available. Please contact HIFUEL.coatedcatalysts@matthey.com for details.

As the research chemicals arm of Johnson Matthey, Alfa Aesar offers HISPEC and HiFUEL catalysts from stock in quantities from gram to kilo-scale. A world leader in precious metal supply and catalyst manufacturing, we are always in a position to offer competitive prices on quality fuel cell products.



Fuel Cell Components

Membrane Electrode Assemblies (MEAs) are truly the heart of the fuel cell and Alfa Aesar now offers a wide range of MEAs for Hydrogen, DMFC and Reformate fuels cells, along with fuel cell components.

PROTON EXCHANGE MEMBRANE FUEL CELLS (PEMFC)

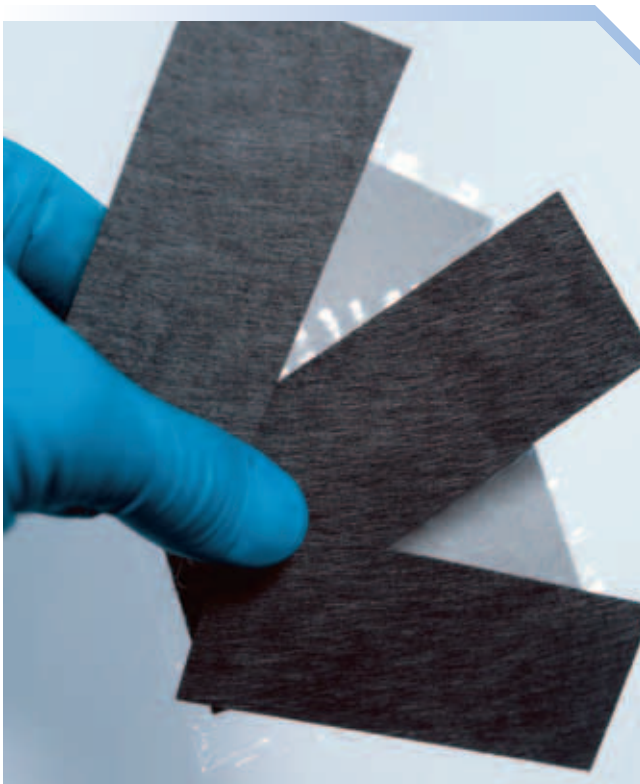
The proton exchange membrane (PEM) fuel cell uses a polymeric membrane as the electrolyte, with platinum electrodes. These cells operate at relatively low temperatures and can vary their output to meet shifting power demands.

DIRECT METHANOL FUEL CELLS (DMFC)

As a relatively new type of fuel cell, the direct-methanol fuel cell is similar to the PEM cell in that it uses a polymer membrane as an electrolyte. However, a catalyst on the DMFC anode draws hydrogen from liquid methanol, eliminating the need for a fuel reformer. Therefore, pure methanol can be used as fuel.

ACHIEVING OPTIMUM PERFORMANCE OF YOUR FUEL CELL PRODUCT

Alfa Aesar provides a range of high quality MEAs and electrodes suitable for a variety of applications and operating conditions. These products are manufactured using standardized production techniques and materials to ensure excellent reproducibility.



OPERATION GUIDELINES

The supplied fuel cell products are designed to operate under a wide range of operating conditions. The general guidelines listed below should help to avoid fuel cell operation errors.

- 1. The cell should always be supplied with enough fuel (and oxidant) to produce the electric current being drawn from the cell; in practice, excess should be supplied.*
- 2. Avoid excessive differential pressures between anode and cathode, as this may damage the membrane.*
- 3. Avoid operation at excessive temperature (>80°C), as this may damage the membrane.*
- 4. Avoid excessive exposure to Open Circuit Voltage (OCV) as this will result in accelerated MEA degradation.*
- 5. Avoid operating the MEAs at very high current densities.*
- 6. When the fuel cell is not in use, purge the system to remove reactants. Otherwise, maintain fuel cell in stand-by operation by returning to the operating parameters used to break-in (or "condition") the MEAs.*
- 7. Any purging of the fuel cell is best done with an inert gas such as nitrogen.*
- 8. Avoid introducing air (oxygen) to the anode electrode where possible, except for the purpose of diagnostic testing. Operation with an air bleed is not recommended as this has significant impact on the lifespan of the MEA.*
- 9. The MEA should not be removed from the cell hardware until all testing has been completed; unnecessary compressing and re-compressing should be avoided.*



Fuel Cell Components

Nafion® Membranes

45036	Nafion membrane, 0.05mm thick <i>NRE-212, Nafion NRE-212 perfluorosulfonic acid-PTFE copolymer, nominally 50 microns thick, standard exchange capacity 0.92 meq/g. Membrane is positioned between a backing film and a cover sheet.</i>	15x15 cm 30x30 cm 60x60 cm
42181	Nafion membrane, 0.09mm thick; high exchange capacity <i>Nafion NE-1035 perfluorosulfonic acid-PTFE copolymer, nominally 90 microns thick, standard exchange capacity 1.0 meq/g</i>	15x15 cm 30x30 cm 60x60 cm
42179	Nafion membrane, 0.125mm thick <i>Nafion N-115 perfluorosulfonic acid-PTFE copolymer, nominally 125 microns thick, standard exchange capacity 0.9 meq/g</i>	15x15 cm 30x30 cm 60x60 cm
42180	Nafion membrane, 0.180mm thick <i>Nafion N-117 perfluorosulfonic acid-PTFE copolymer, nominally 180 microns thick, standard exchange capacity 0.9 meq/g</i>	15x15 cm 30x30 cm 60x60 cm

Toray™ Carbon Paper

45356	Toray Carbon Paper, TGP-60	19x19 cm
45365	Toray Carbon Paper, Teflonated, TGP-60	19x19 cm
45360	Toray Carbon Paper, Baselayered, TGP-60	12x12 cm

Cathodes and Anodes for DMFC

45359	Direct Methanol Fuel Cell (DMFC) Anode	25 cm ²
45367	Direct Methanol Fuel Cell (DMFC) Anode	50 cm ²
45374	Direct Methanol Fuel Cell (DMFC) Anode	100 cm ²
45361	Direct Methanol Fuel Cell (DMFC) Cathode	25 cm ²
45368	Direct Methanol Fuel Cell (DMFC) Cathode	50 cm ²
45375	Direct Methanol Fuel Cell (DMFC) Cathode	100 cm ²

Cathodes and Anodes for Hydrogen, and Reformate Fuel Cells

45358	Reformate Anode	25 cm ²
45366	Reformate Anode	50 cm ²
45373	Reformate Anode	100 cm ²
45357	Hydrogen Electrode/Reformate Cathode	25 cm ²
45452	Hydrogen Electrode/Reformate Cathode	50 cm ²
45372	Hydrogen Electrode/Reformate Cathode	100 cm ²

Stock	Description	Size
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MEAs for Hydrogen, DMFC and Reformate Fuel Cells

MEAs FOR DMFC FUEL CELLS

45364	Direct Methanol Fuel Cell (DMFC) Screener Membrane Electrode Assembly (MEA-5 layer), Active Area 25 cm ² , plus membrane	25 cm ²
45371	Direct Methanol Fuel Cell (DMFC) Screener Membrane Electrode Assembly (MEA-5 layer), Active Area 50 cm ² , plus membrane	50 cm ²
45378	Direct Methanol Fuel Cell (DMFC) Screener Membrane Electrode Assembly (MEA-5 layer), Active Area 100 cm ² , plus membrane	100 cm ²

MEAs FOR HYDROGEN FUEL CELLS

45362	Hydrogen Screener Membrane Electrode Assembly (MEA-5 layer), Active Area 25 cm ² , plus membrane border	25 cm ²
45369	Hydrogen Screener Membrane Electrode Assembly (MEA-5 layer), Active Area 50 cm ² , plus membrane border	50 cm ²
45376	Hydrogen Screener Membrane Electrode Assembly (MEA-5 layer), Active Area 100 cm ² , plus membrane border	100 cm ²

MEAs FOR REFORMATE FUEL CELLS

45363	Reformate Screener Membrane Electrode Assembly (MEA-5 layer), Active area 25 cm ² , plus membrane border	25 cm ²
45370	Reformate Screener Membrane Electrode Assembly (MEA-5 layer), Active Area 50 cm ² , plus membrane border	50 cm ²
45377	Reformate Screener Membrane Electrode Assembly (MEA-5 layer), Active Area 100 cm ² , plus membrane border	100 cm ²

HiSPEC™ Fuel Cell Catalysts

Johnson Matthey, the world leader in fuel cell catalysts, offers the following line of catalysts specially formulated for PEM fuel cells. They have been used with success in both anodes and cathodes. The HiSPEC catalysts are all made to a consistently high quality on a commercial scale, and are readily available in gram and kilogram quantities. They are supported on a conducting high surface area carbon, and are particularly suited to the manufacture of active electrode structures.

HiSPEC Product Range

Pt Black and Pt/Ru Black (non-supported)

12755	12755 PT Black HiSPEC 1000	250 mg 1 g 5 g
41171	41171 Platinum Ruthenium black, HiSPEC 6000, nominally Pt 50%, Ru 50% (Atomic wt%)	250 mg 1 g 5 g 25 g



Stock	Description	Size
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Pt and Pt/Ru on Standard Carbon Support

43876	Platinum, HISPEC 2000,	500 mg
	nominally 10% on carbon black	2 g
		10 g
		50 g
35849	Platinum, HISPEC 3000,	1 g
	nominally 20% on carbon black	5 g
		25 g
42204	Platinum, HISPEC 4000,	1 g
	nominally 40% on carbon black	5 g
		25 g
43989	Platinum, HISPEC 8000,	1 g
	nominally 50%, on carbon black	5 g
		25 g
44171	Platinum, HISPEC 9000,	1 g
	nominally 60%, on carbon black	5 g
		50 g
40473	Platinum, HISPEC 5000, nominally 20%, Ruthenium,	250 mg
	nominally 10% on carbon black	1 g
		5 g
		25 g
44172	Platinum, HISPEC 10000, nominally 40%, Ruthenium,	2 g
	nominally 20% on carbon black	10 g
		50 g

Pt and Pt/Ru on High Surface Area Carbon Support

44728	Platinum, HISPEC 9100, nominally 60% on high.	1 g
	surface area advanced carbon support	5 g
		25 g
45041	Platinum, HISPEC 13100, nominally 70% on high.	1 g
	surface area advanced carbon support	5 g
45040	Platinum, HISPEC 12100, nominally 50%, Ruthenium nominally 25% on high	1 g
	surface area advanced carbon support	5 g

Pt/Ru on Compressed Carbon Support

45039	Platinum, HISPEC 10300, nominally 40%, Ruthenium nominally 20% on 50%	1 g
	compressed carbon black	5 g

HiFUEL™ Catalysts

Alfa Aesar now offers Johnson Matthey's range of HiFUEL fuel processing catalysts and gas treatment products.

These base metal catalysts are ideal for use in fuel cell and other distributed hydrogen production applications. Their small size, high geometric surface areas, and high volumetric activity make them well suited to compact reactor designs. Reforming, water gas shift and purification products are available.

A complementary range of HiFUEL precious metal catalysts is also available for fuel processing applications. These catalysts are custom coated onto tailored supports for optimum performance and precious metal use. Please contact HiFUEL.coatedcatalysts@matthey.com for details.

The HiFUEL range of catalysts complement the Johnson Matthey HiSPEC fuel cell catalyst products.

Bulk
Quantities
Available
from Stock

HiFUEL Catalysts Product Range

45465	Nickel based steam reforming catalyst, HiFUEL R110 <i>4-hole, 4-flute domed cylinders</i>	500 g 1 kg 2.5 kg
45468	Copper based methanol reforming catalyst, HiFUEL R120 <i>Pellets, 5.2mm x 3.0mm</i>	500 g 1 kg 2.5 kg
45467	Iron-chrome based high temperature water gas shift catalyst, HiFUEL W210 <i>Pellets, 5.4mm x 3.6mm</i>	500 g 1 kg 2.5 kg
45466	Copper based low temperature water gas shift catalyst, HiFUEL W220 <i>Pellets, 3.1mm x 3.1mm</i>	500 g 1 kg 2.5 kg
45470	Copper based medium temperature water gas shift catalyst, HiFUEL W230 <i>Pellets, 5.2mm x 3.0mm</i>	500 g 1 kg 2.5 kg
45469	Zinc oxide based sulfur removal material, HiFUEL A310 <i>Spheres, 2-5mm dia</i>	500 g 1 kg 2.5 kg

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Fuel Cells

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