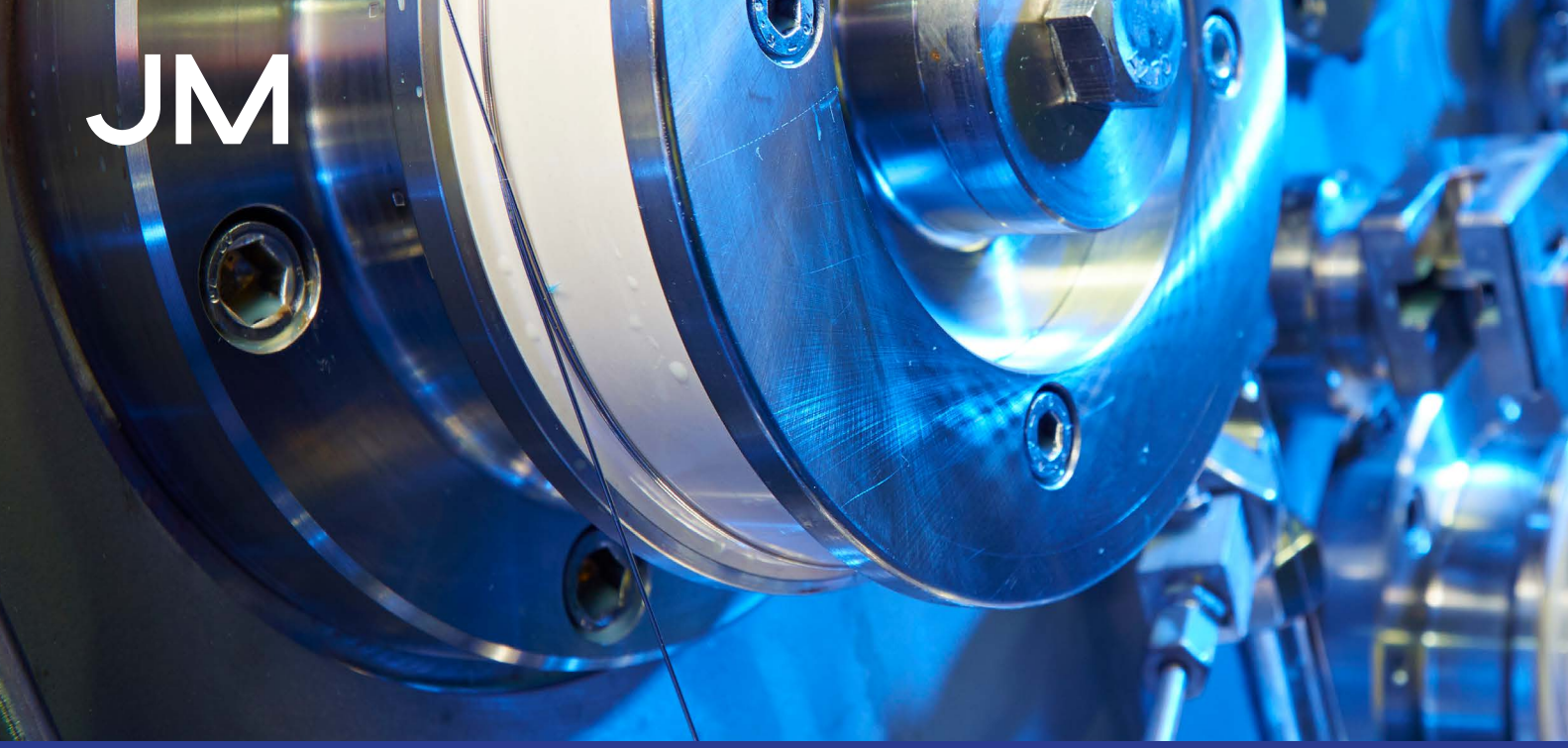

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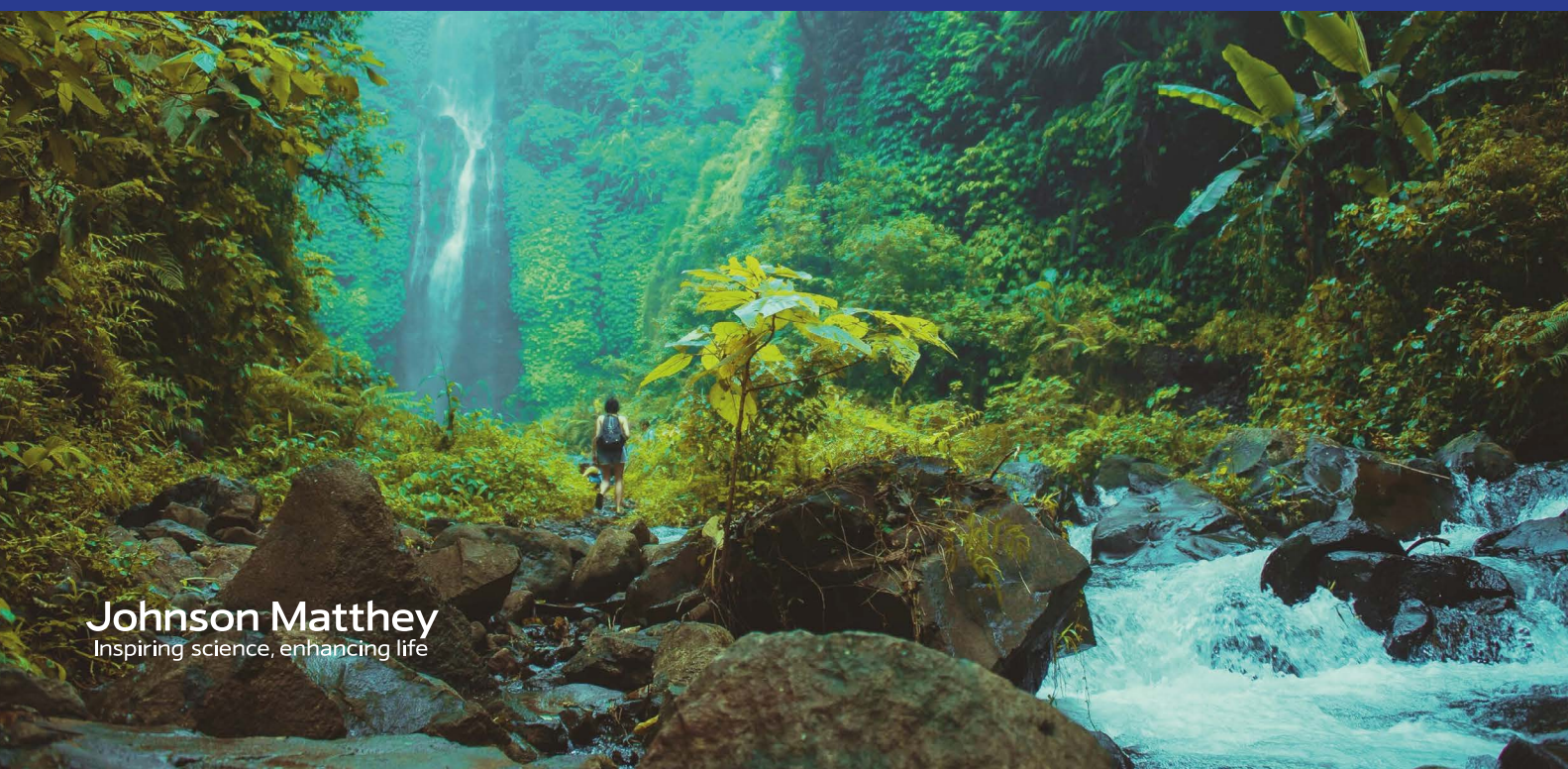

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Ignition materials

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Ignition materials

Our range of single element and alloyed ignition products has been developed by our expert metallurgists in conjunction with industry and academic partners to provide our customers with superior products and a distinct technical advantage.

We supply a range of industries, including automotive and aerospace, which rely upon high quality ignition products. As a leading manufacturer of fabricated platinum group metal products, we have the experience and technical expertise required to offer difficult-to-work metals and alloys in the geometries our customers require; whether that be lengths of wire or pre-cut electrode tips.

In recent years Johnson Matthey has made a significant investment not only into the research and development of new ignition materials but also into novel test methods, process improvements and enhanced quality assurance. This culminated in the development of a new ignition alloy for one of our automotive customers, helping them develop their next generation of products by achieving a 50% increase in material strength.

We also offer a range of flexible consignment and metal management options to give you the products you need, when you need them.

Typical alloys

- 5-30% Rhodium/Platinum
- 5-30% Iridium/Platinum
- Platinum/Zirconia (ZGS Platinum)
- 10% Rhodium/Platinum/Zirconia
- Silver/Palladium (various available)

Pure metals

Platinum	Up to 99.998%
Palladium	Up to 99.99%
Iridium	Up to 99.9%
Rhodium	Up to 99.95%
Gold	Up to 99.995%

Europe
Tel: +44 1763 253000
Fax: +44 1763 253313
Email: nobleuk@matthey.com

USA
Tel: +1 610 648 8000
Fax: +1 610 648 8105
Email: nobleww@jmusa.com

Asia
Tel: +852 2738 0380
Fax: +852 2736 2222
Email: jmhk@mattheyasia.com

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Jewelry

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Precious metal alloys for jewelry manufacturers and craftsmen

Johnson Matthey has a rich history of supplying high quality pure and alloyed platinum group metals into the jewelry industry. In addition to our products we offer a reliable service with exceptional supply continuity, a full refining service and flexible metal management options.

We are able to offer platinum group metals in a variety of forms including plate, wire, casting grain, tube and chopped rod. Our network of logistics experts enables us to serve customers around the globe from our manufacturing sites in North America and Europe. We also offer a range of additional services such as closed-loop refining, flexible metal management and a variety of payment and finance options.

Choosing the correct jewelry alloy is a difficult process requiring a careful balance of aesthetics, castability, hardness, process requirements and regulatory considerations. Johnson Matthey eases this burden by offering a range of alloys designed to provide desirable material properties whilst being compatible with a broad spectrum of production methods such as casting, wrought and hand worked fabrication as well as automated methods such as stamping.

Alloy	Alloying elements	Fineness (parts per thousand)	Melting range (°C) solid	Melting range (°C) liquid	Hardness (HV)	Annealed (% elong.)	Density (g/cm^3)	Key characteristics
Pure platinum		999	1769	1769	50	40	21.4	
HPP platinum		999	1769	1769	55	35	21.4	Improved hardness and strength
FP platinum	3% Cu	970	1740	1755	120	30	20.6	Soft for settings
GW platinum	4.5% Cu	955	1725	1745	125 / 108 (c)	29	20.0	General purpose, medium hard, can be cast
HC platinum	4.5% Co	955	1750	1765	135	20	20.8	Fluid for hard castings
SC 950 platinum	5% Pd	950	1755	1765	60 / 68 (c)	22 / 22(c)	20.6	Castings, delicate settings
SC 900 platinum	10% Pd	900	1740	1755	80 / 72 (c)	22 / 22(c)	19.8	General purpose
SC 850 platinum	15% Pd	850	1730	1750	90 / 64(c)	22 / 22(c)	19.1	Chain making
HM platinum	4.5% Ru	955	1780	1795	130	32	20.7	General purpose, good matching properties
HS platinum	Proprietary	950	1370	1520	300 / 220(c)	10	19.4	Hard springy, can be cast for catches
Palladium	5% Ru Proprietary	950	1499	1521	125	35	11.8	Hard and durable alloy, suitable for casting
Palladium	5% Ru	950	1558	1580	115	30-35	11.9	Suitable for cold worked pieces

Europe
Tel: +44 1763 253000
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USA
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Email: nobleww@jmusa.com

Asia
Tel: +852 2738 0380
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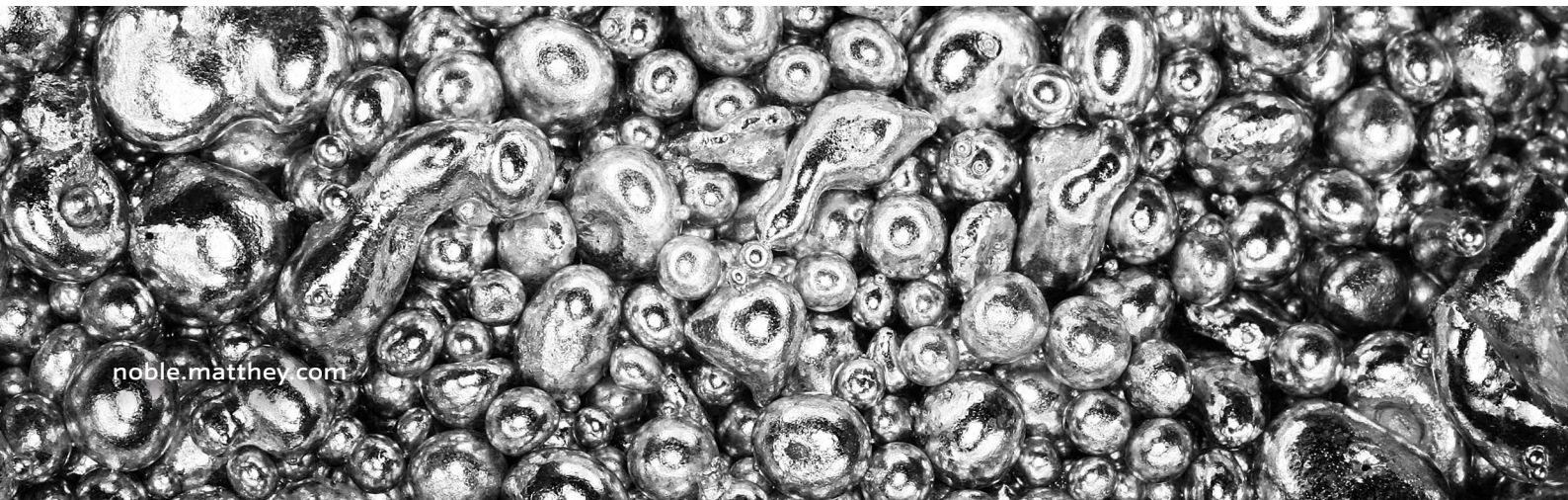

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Platinum group metal sheets and foils

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Platinum group metal sheets and foils

Johnson Matthey offer a wide range of platinum group metal (pgm) sheet and foils used in many applications including fine jewellery, sensors, electrical contacts and fabrications for the glass industry.

A combination of high-tech equipment and in-house expertise enables us to produce a range of pgm sheets, including ultra-thin foils and ribbons. If required, these materials can be processed further into more complex geometries using our high precision tooling. We are also able to provide rhodium foils of exceptional quality and reliability for use in digital mammography scanners.

It's just one of the ways that our products flow from our labs into applications that enhance everyday life.

Pure metals	
Platinum	Up to 99.998%
Palladium	Up to 99.99%
Iridium	Up to 99.9%
Rhodium	Up to 99.95%
Gold	Up to 99.995%

We also offer a range of additional services, such as closed-loop pgm recycling and metal management options.

Sheets & foils – Typical materials, thicknesses and widths*

Material	Min. Thickness (mm)	Max. Thickness (mm)	Max. Width (mm)
Pt	0.1	20	500
ZGS Pt	0.1	20	500
RhPt	0.1	20	500
ZGS 10%RhPt	0.1	20	500
Pd	0.1	20	500
Rh	0.025	20	500
Ir	0.25	10	500
Other Pt alloys	0.1	20	500

*Thicknesses and widths are interdependent.
Please contact us with your specific requirements.

Europe
Tel: +44 1763 253000
Fax: +44 1763 253313
Email: nobleuk@matthey.com

USA
Tel: +1 610 648 8000
Fax: +1 610 648 8105
Email: nobleww@jmusa.com

Asia
Tel: +852 2738 0380
Fax: +852 2736 2222
Email: jmhk@mattheyasia.com

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Thermocouple wire and assemblies

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Thermocouple wire and assemblies

Our customers trust us to provide them with accurate and reliable thermocouple products. We have earned that trust by consistently supplying high quality thermocouple wire and by providing greater value through investment in research and development.

We offer type R, type S and type B thermocouple wire, as well as other more specialised combinations. Thermocouples are calibrated in our UKAS accredited laboratory, in line with international standards. Our customers expect the best, so we ensure that we are providing products of the highest quality with a security of supply that can be depended upon.

Our research and development is always focussed on technologies that provide greater value for our customers, whether it is improving product lifetime, enhancing performance or reducing costs. This has most recently been demonstrated by our high strength HTX™ platinum thermocouple wire and long length mineral insulated thermocouples, available up to 18m.

Type	Combination		Working temperature range (°C)			Tolerance
	-ve	+ve	Bare wire only Continuous use	Bare wire only Intermittent use	Mineral insulated form	
S	Pt	10% RhPt	200-1500	200-1650	200-1300	IEC 584-2 Class 1
R	Pt	13% RhPt	200-1500	200-1650	200-1300	IEC 584-2 Class 1
B	6% RhPt	30% RhPt	200-1600	200-1750	200-1450	IEC 584-2 Class 2
	20% RhPt	40% RhPt	200-1700	200-1850	200-1450	8.0°C
	Iridium	40% IrRh	1000-2100		N/A	10.0°C
	0.03% FeAu	Chromel	1-300 K		N/A	

For more information about our HTX™ platinum thermocouple please visit our website.

Europe
Tel: +44 1763 253000
Fax: +44 1763 253313
Email: nobleuk@matthey.com

USA
Tel: +1 610 648 8000
Fax: +1 610 648 8105
Email: nobleww@jmusa.com

Asia
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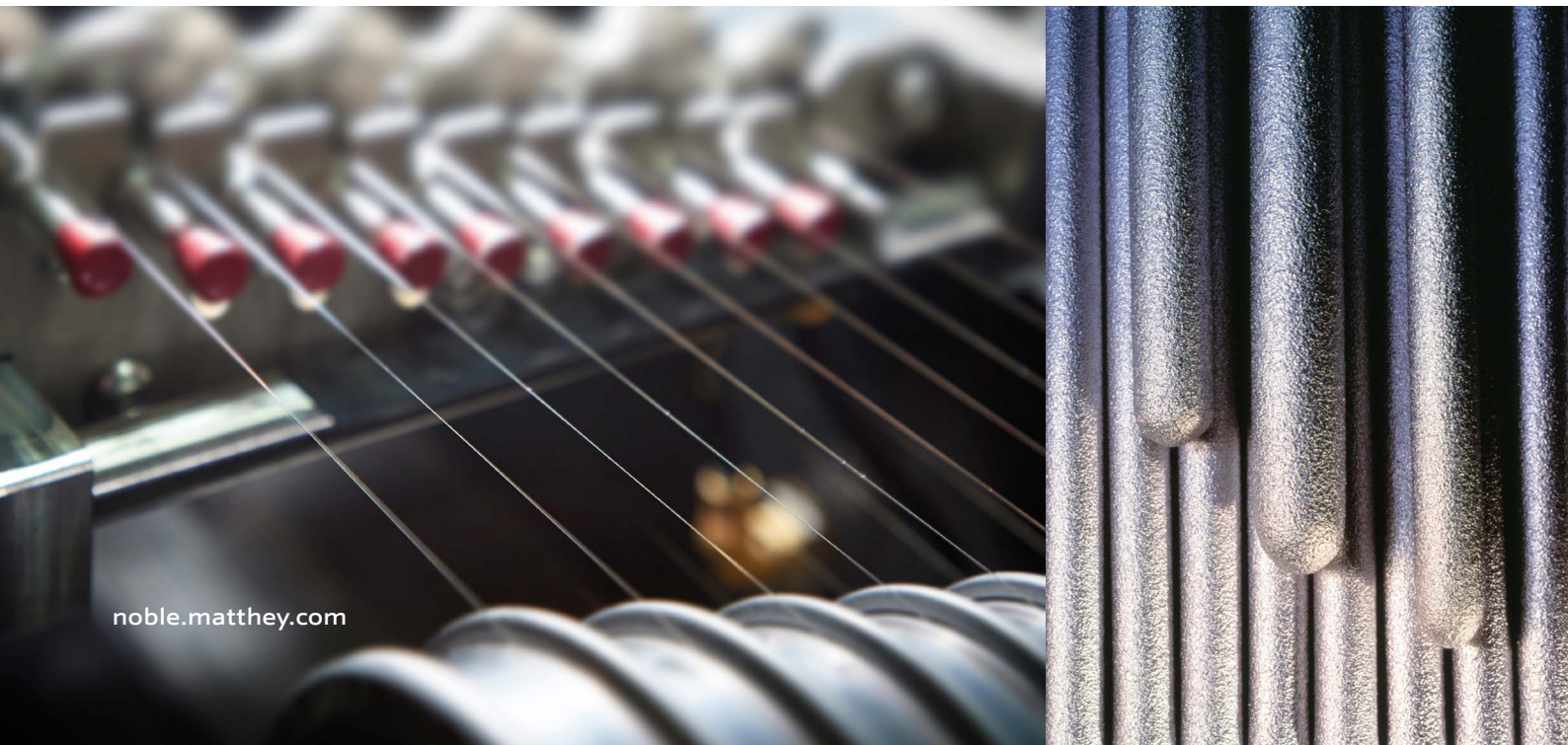

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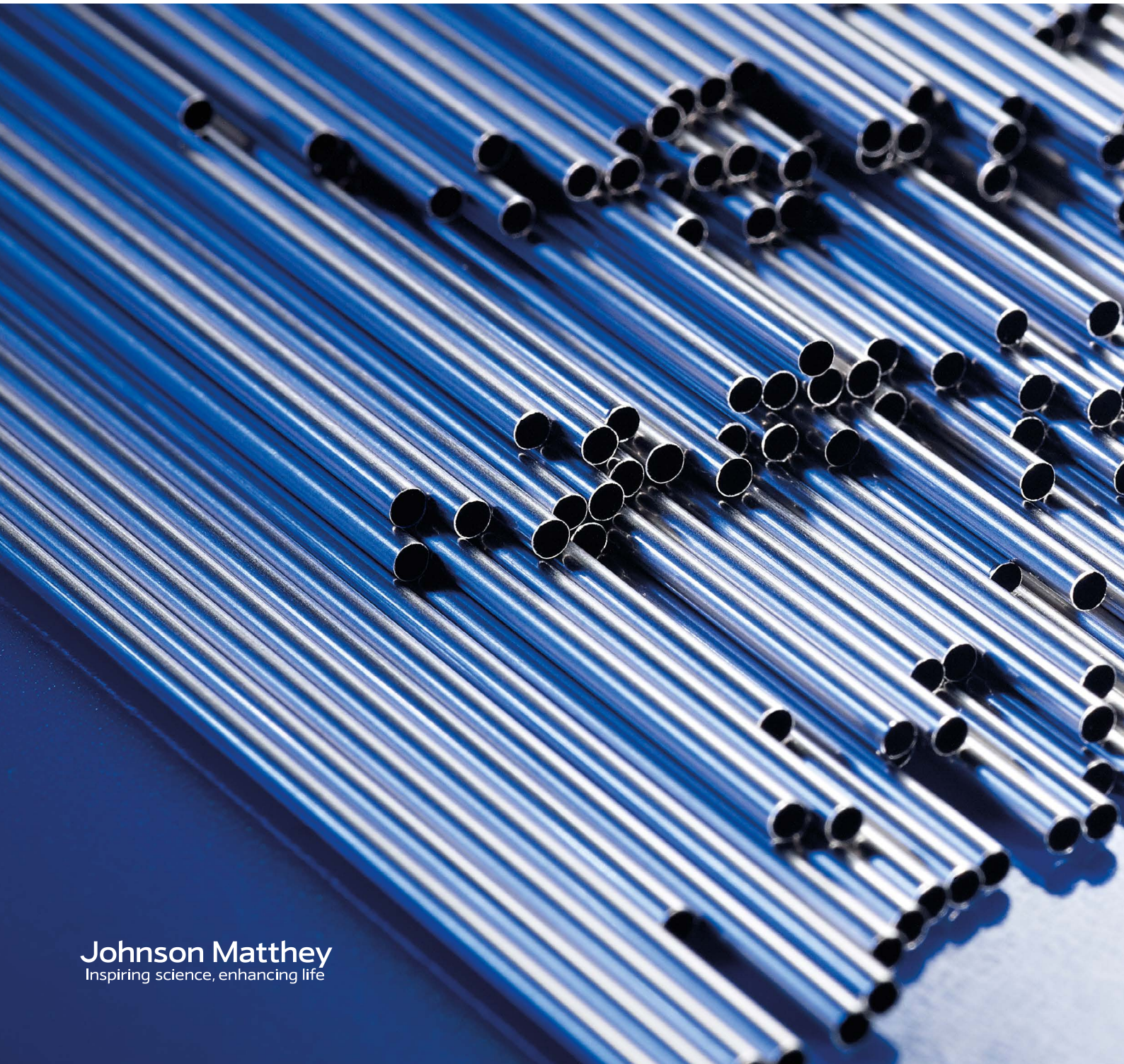
Platinum group metal tube



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Platinum group metal tube

We offer a range of high quality platinum group metal (pgm) tube used in industrial, jewellery and medical applications. Whether it is manufactured through our proprietary extrusion process or precision drawn by our expert engineers, we can provide a solution tailored to your needs.

Our tubes are available in a range of materials, diameters and wall thicknesses as well as a choice of round, oval or square profiles. The tube itself is just part of the package we offer, which includes on-going customer support and a closed-loop pgm recycling service.

Applications for our tube include hydrogen purification & separation, thermocouple protection sheaths and various uses within the aerospace industry.

Typical diameters and lengths

- All of our tubes are available with outside diameters of 0.3 mm – 30.0 mm, with some available down to 0.1 mm.
- The maximum length is 3.5 m, depending on weight restrictions and wall thickness.

We offer precision cut, burr free thin walled tubes in addition to eddy current and pressure testing to ensure tube integrity.

Typical alloys

- 5-30% Rhodium/Platinum
- 5-30% Iridium/Platinum
- Platinum/Zirconia (ZGS Platinum)
- 10% Rhodium/Platinum/Zirconia
- Silver/Palladium (various available)

Pure metals	
Platinum	Up to 99.998%
Palladium	Up to 99.99%
Gold	Up to 99.9985%

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Fax: +44 1763 253313
Email: nobleuk@matthey.com

USA
Tel: +1 610 648 8000
Fax: +1 610 648 8105
Email: nobleww@jmusa.com

Asia
Tel: +852 2738 0380
Fax: +852 2736 2222
Email: jmhk@mattheyasia.com

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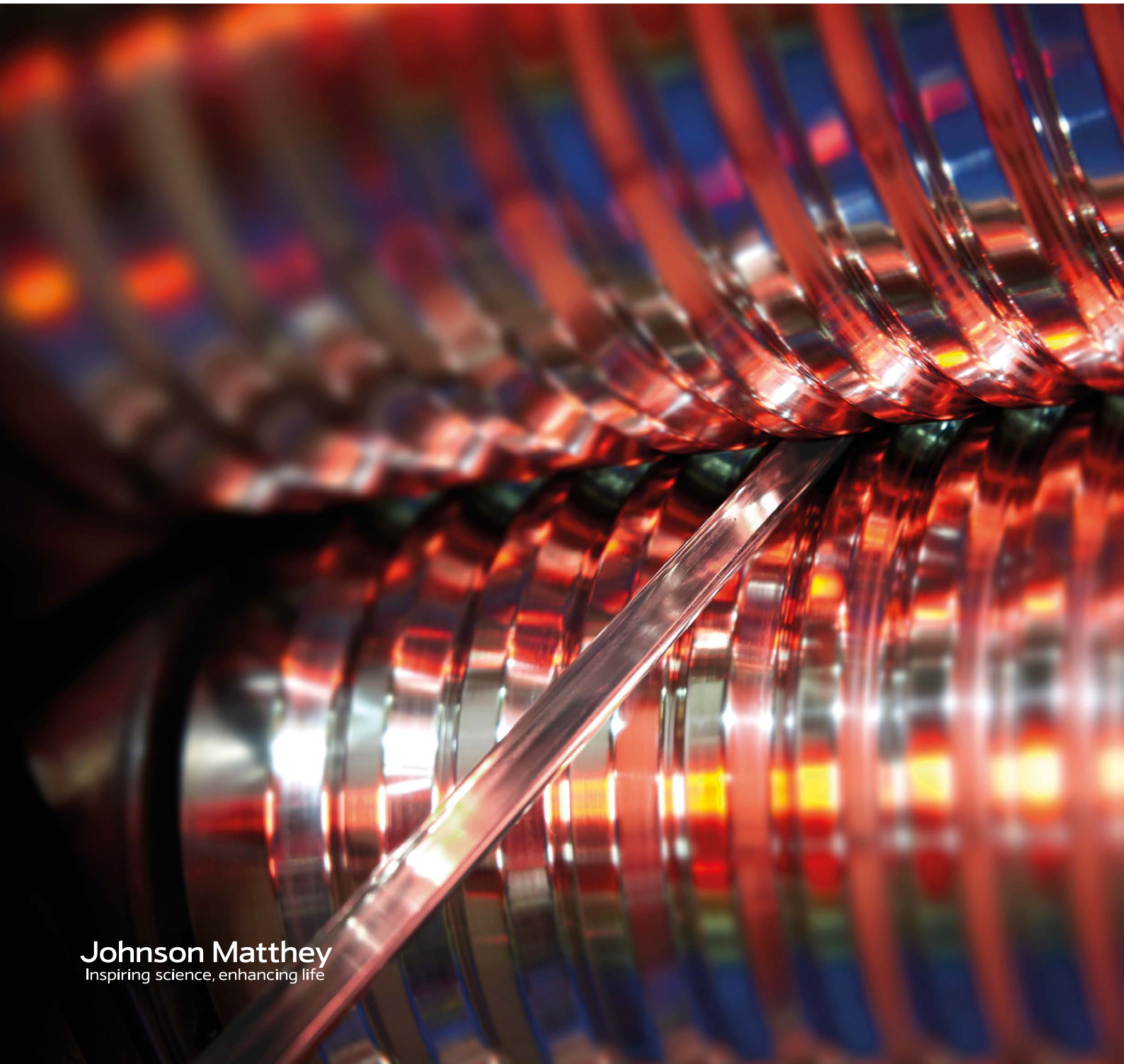
Platinum group metal wire



Johnson Matthey
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Platinum group metal wire

A combination of experience and continuous innovation yields quality, reliability and precision. That is why our wires are used in critical applications such as airbag initiators, gas sensors and turbine blade casting.

Our range of wires can be manufactured to meet the exact needs of your application. We offer wire as straight lengths, wound on reels or as precision cut pins in a selection of pure metals and alloys.

State-of-the-art quality control allows us to offer you reliable solutions that come with complete peace of mind. Our exceptional customer service connects you directly with the expertise you require.

Our research and development is always focussed on technologies that provide greater value for our customers, whether it is improving product lifetime, enhancing performance or reducing costs. This has most recently been demonstrated by the development of a new lower cost material for the turbine blade casting industry.

Pure metals	
Platinum	Up to 99.998%
Palladium	Up to 99.99%
Iridium	Up to 99.9%
Rhodium	Up to 99.95%
Gold	Up to 99.995%

Typical diameters and lengths

Our wire can be engineered to your desired thickness with typical diameters of 0.15-12.5mm for rhodium and iridium and 0.025-12.5mm for most alloys. Ultrafine wire can also be engineered on request in the range of 0.010 – 0.025mm.

Typical alloys

- 5-40% Rhodium/Platinum
- 5-30% Iridium/Platinum
- 8% Tungsten/Platinum
- Platinum/Zirconia (ZGS Platinum)
- 10% Rhodium/Platinum/Zirconia
- Silver/Palladium (various available)
- 15% Molybdenum/Palladium
- Gold/Copper/Silver (JM625 alloy)

A variety of regalohm alloys are available with specific resistance in the range of 6-62 μΩ cm details of which can be found on our website.

Europe
Tel: +44 1763 253000
Fax: +44 1763 253313
Email: nobleuk@matthey.com

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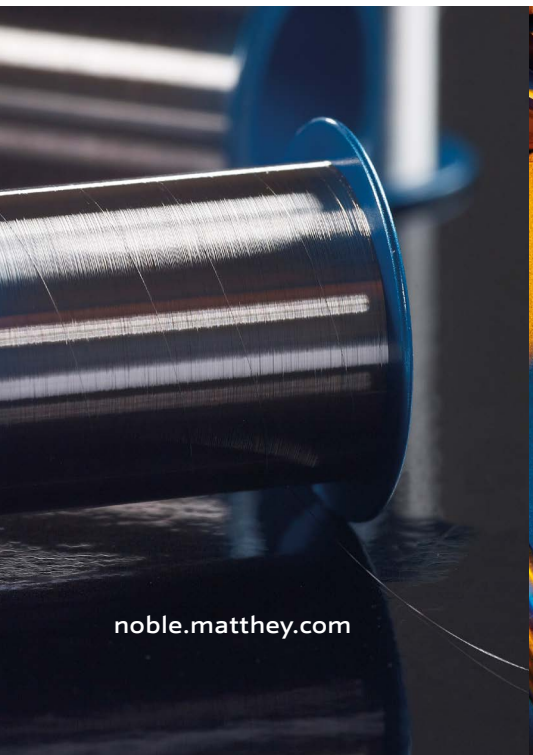

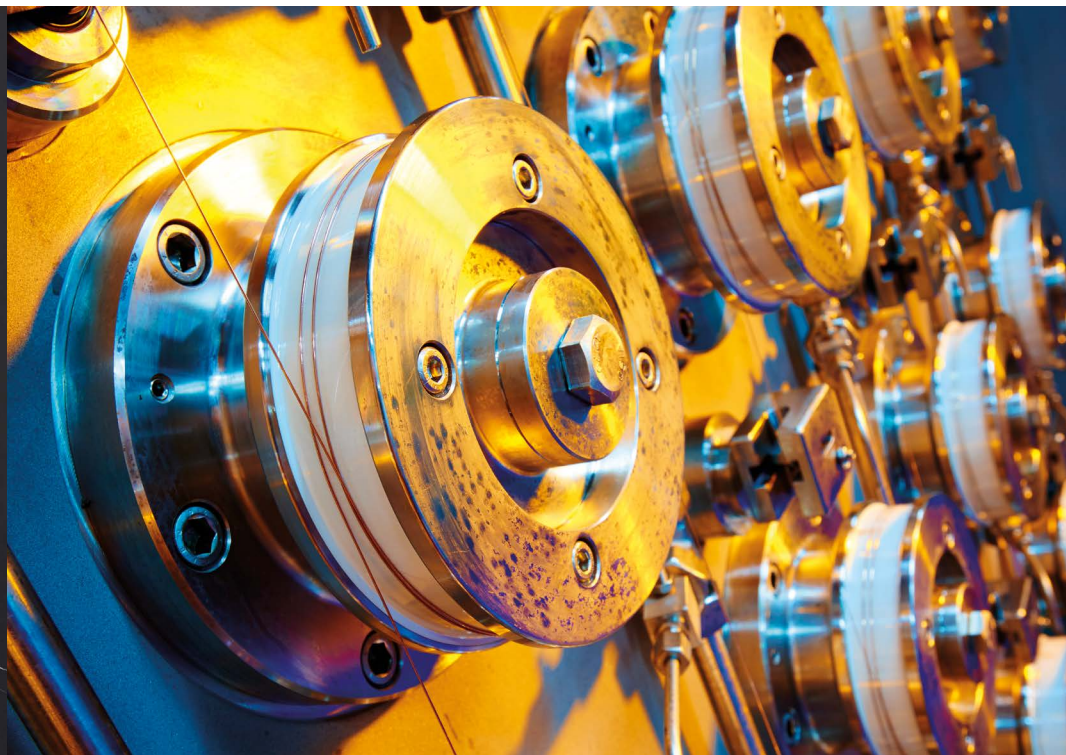

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Platinum group metal fabrications

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Platinum group metal fabrications

Our expert knowledge of precious metals has made us a trusted supplier of platinum group metal (pgm) fabrications. We supply a range of customers from laboratories and crystal growers to glass manufacturers, where our inert products provide high strength and unequalled resistance to corrosion.

We tailor our products to meet your specific requirements, helping to reduce costs and maximise benefits such as extended equipment life, shape retention and fewer defects in the end product.

As well as exceptional products, we provide unparalleled technical expertise, on-going customer support and a closed-loop pgm recycling service.

Typical fabrications include:

- Iridium crucibles used to grow various metal oxide single crystals, including scintillation crystals used in medical (PET) scanners and mobile phones as well as those used in liquid crystal display backlighting.
- Self-supported pgm fabrications and linings for use in the glass industry. We supply customised sheet, tube for bubblers, drains and thermocouple sheaths plus more complex parts such as stirrers, spout bowls, refiners and feeder chambers. All manufactured to meet your specific needs.
- Platinum group metal crucibles, dishes, beakers, forceps, triangles and gauze baskets for use in analytical laboratories. The capacities and shapes available meet most laboratory requirements and we can custom make anything you require.

Europe
Tel: +44 1763 253000
Fax: +44 1763 253313
Email: nobleuk@matthey.com

USA
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Fax: +1 610 648 8105
Email: nobleww@jmusa.com

Asia
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Fax: +852 2736 2222
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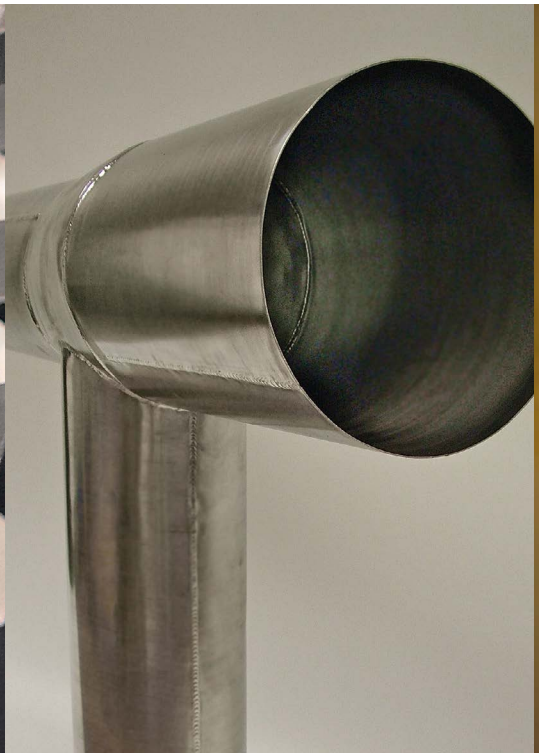

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Advanced coating technology

Johnson Matthey
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Advanced coating technology (ACT™)

Johnson Matthey is a long-established supplier to the glass industry, providing a range of platinum group metal (pgm) solutions to meet our customers' needs. Our ACT™ coatings can improve the efficiency of your process and the quality of your glass.

Ceramics are protected through a thin coating of platinum or 10% rhodium/platinum that provides a protective layer against corrosion. Our coatings help to reduce costs by decreasing downtime, extending the life of the ceramic parts and providing fewer defects in the end product. ACT™ coatings offer:

- Resistance to corrosion from molten glass, including soda lime, crystal, borosilicate and opal.
- 100% shape retention for the lifetime of the coating.
- Protection of the glass line.
- Protection against corrosive vapour condensates.

ACT™ coatings can be applied to the majority of refractory materials, including feeder consumables and furnace blocks. The flexible process means that more complex fabrications can be coated if required.

We offer ongoing technical support and a closed-loop pgm recycling service with typical returns exceeding 95%.

Typical materials:

Platinum 99.95%	Up to 1300°C
10% Rhodium/Platinum	Up to 1600°C

Typical thickness:

Feeder consumables and specialised products	200-400 microns
Furnace blocks	400-500 microns

Europe
Tel: +44 1763 253000
Fax: +44 1763 253313
Email: nobleuk@matthey.com

USA
Tel: +1 610 648 8000
Fax: +1 610 648 8105
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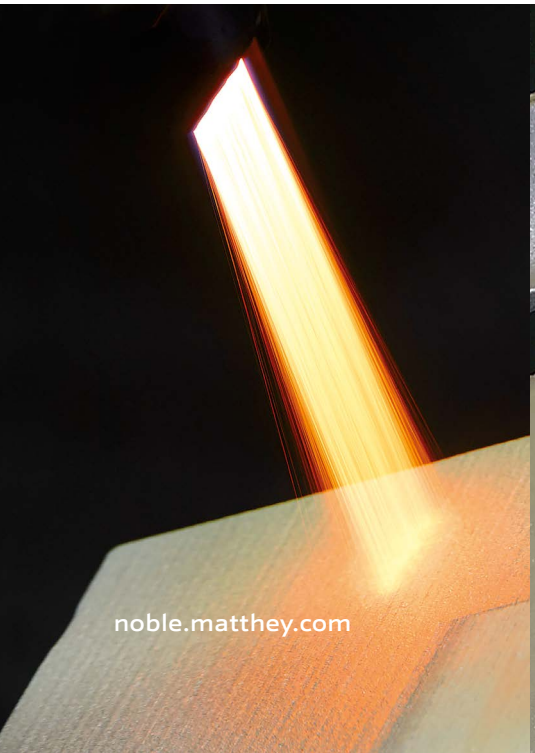

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HTX™ platinum thermocouple wire

Extra strength, exceptional accuracy

Johnson Matthey
Inspiring science, enhancing life

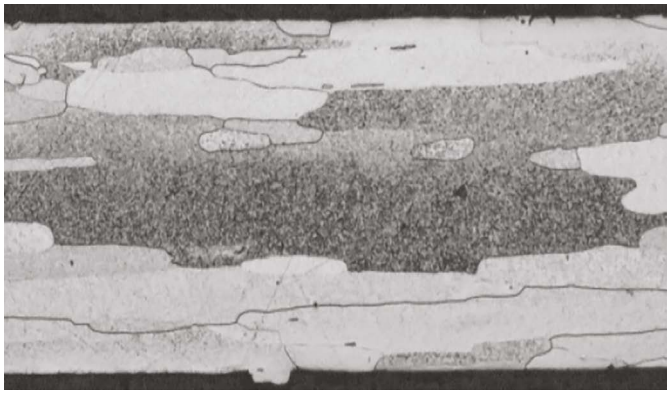
HTX™ platinum thermocouple wire

Through our latest innovation we have developed HTX™ platinum thermocouple wire: a high strength thermocouple wire that withstands the most demanding applications, particularly those seen in the semiconductor industry.

We are able to stabilise the grain boundaries in our HTX™ wire to give it outstanding strength compared to our standard platinum wire. This stabilisation prevents grains occupying the complete wire diameter and stops bamboo structures developing from the grains being easily displaced. Containing the grains allows the temperature measurement to be maintained, offering reliability in harsh environments.

HTX™ wire provides superior durability. It maintains excellent functionality after 1,200 hours at 1400°C with 400psi tensile loading during accelerated life testing. It also shows exceptional measurement accuracy, meeting IEC 60584-1 class 1 tolerance.

Our HTX™ wire is available as type R and type S thermocouples, and we can manufacture it in any diameter within our typical size range to meet your specific requirements.



HTX™ Pt wire

Standard Pt wire with grain boundary movement

Europe
Tel: +44 1763 253000
Fax: +44 1763 253313
Email: nobleuk@matthey.com

USA
Tel: +1 610 648 8000
Fax: +1 610 648 8105
Email: nobleww@jmusa.com

Asia
Tel: +852 2738 0380
Fax: +852 2736 2222
Email: jmhk@mattheyasia.com

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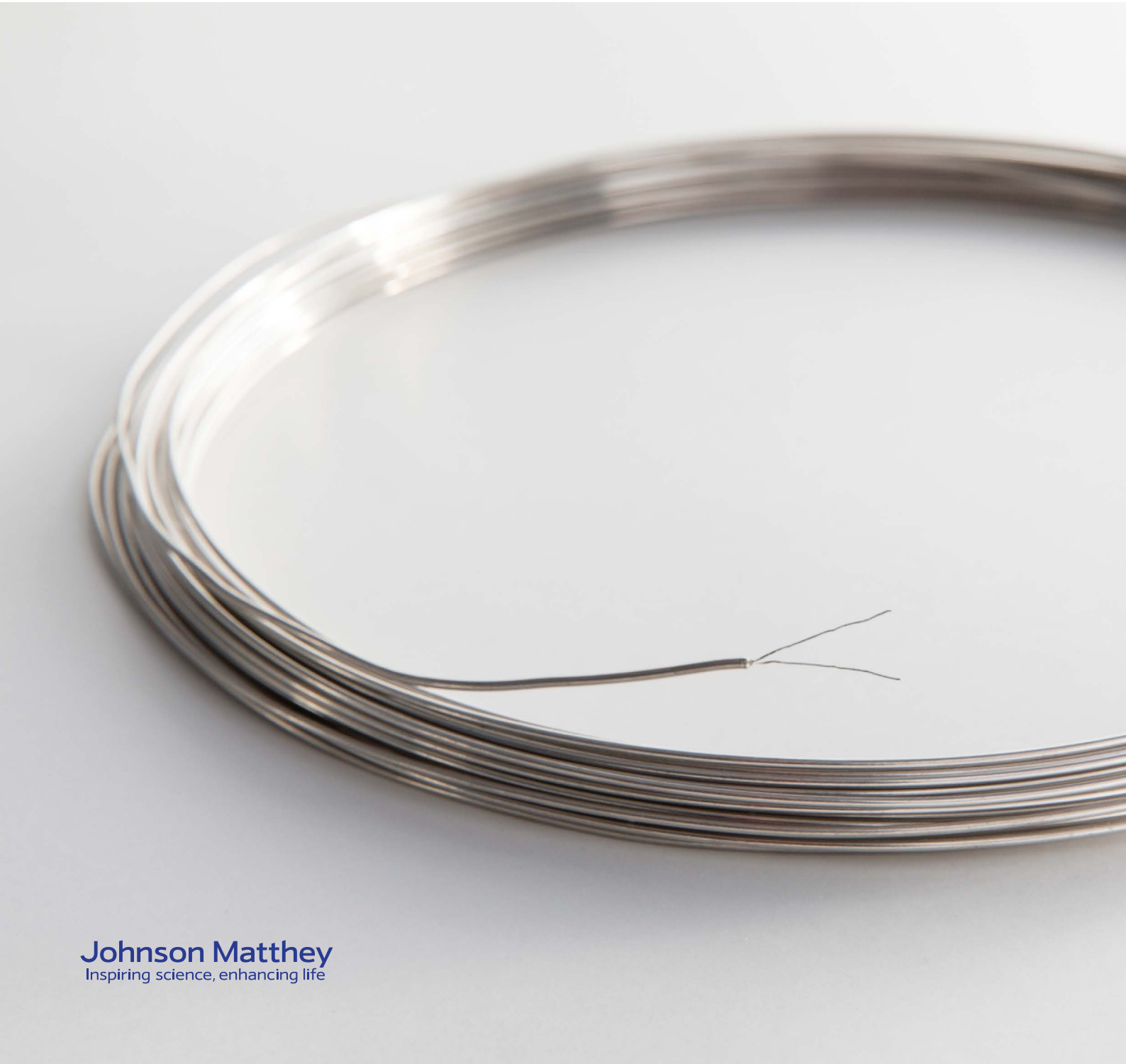
Mineral insulated metal sheathed thermocouples



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Mineral insulated metal sheathed thermocouples

For a number of years we have made superior noble metal mineral insulated metal sheathed (MIMS) thermocouple assemblies and cables.

MIMS thermocouples consist of fine diameter thermocouple wires embedded in high purity magnesia refractory surrounded by a metal sheath. Compared to other methods of temperature measurement, MIMS thermocouples provide exceptional accuracy, extended service life and lower temperature drift. Because of these properties, it is becoming a regulatory requirement to use them in many high performance applications.

MIMS thermocouples offer several benefits compared to bare wire thermocouples, including:

- Flexibility and compactness; they can be bent around small radii (down to four times the MIMS diameter), allowing difficult heat zones to be measured
- A quick response to temperature change; the high conductivity of the sheath reduces the thermal lag in temperature measurement
- Being extremely resistant to mechanical and thermal shock
- Resistance to chemical and atmospheric attack
- Meeting the rigorous demands of AMS 2750 standards
- Availability to ASTM E2181M

They offer an excellent means of measuring very high temperatures, with the low thermal mass giving an extremely quick response to temperature change. Users of vacuum furnaces, whether for melting, casting, heat treatment or brazing, find the impervious metal sheath and small size of MIMS thermocouples offer unequalled advantages compared to any other methods of temperature measurement.

The thermocouple wire we manufacture for our MIMS assemblies and cables is made to international standards; type R and S comply to Class 1 tolerance while type B meets Class 2 tolerance, as detailed in IEC 584-2 (BS EN 60584-1) based on the International Temperature Scale of 1990 (ITS – 90). We test the MIMS in our UKAS accredited calibration laboratory at 1000°C and can supply a certificate detailing emf outputs.

In response to industry demands to make MIMS thermocouples longer, we have recently developed our process to achieve dramatic increases in single unit lengths while also reducing lead times. We can now manufacture various diameter MIMS thermocouples up to 18m long. For customers using MIMS cable to make finished assemblies, this offers greater flexibility, efficiency and yields, as well as lower scrap.

Diameters available: 1mm – 3.2mm
Lengths available: Up to 18m in one continuous length

Recommended operating temperatures

Type	Sheath material	Thermocouple combination		Maximum recommended operating temperature	
		-ve	+ve	Continuous use	Intermittent use
S	10 % Rh/Pt	Pt	10% Rh/Pt	1300°C	1450°C
R	10 % Rh/Pt	Pt	13% Rh/Pt	1300°C	1450°C
B	10 % Rh/Pt	6% Rh/Pt	30% Rh/Pt	1450°C	1600°C
B	20 % Rh/Pt	6% Rh/Pt	30% Rh/Pt	1450°C	1600°C

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