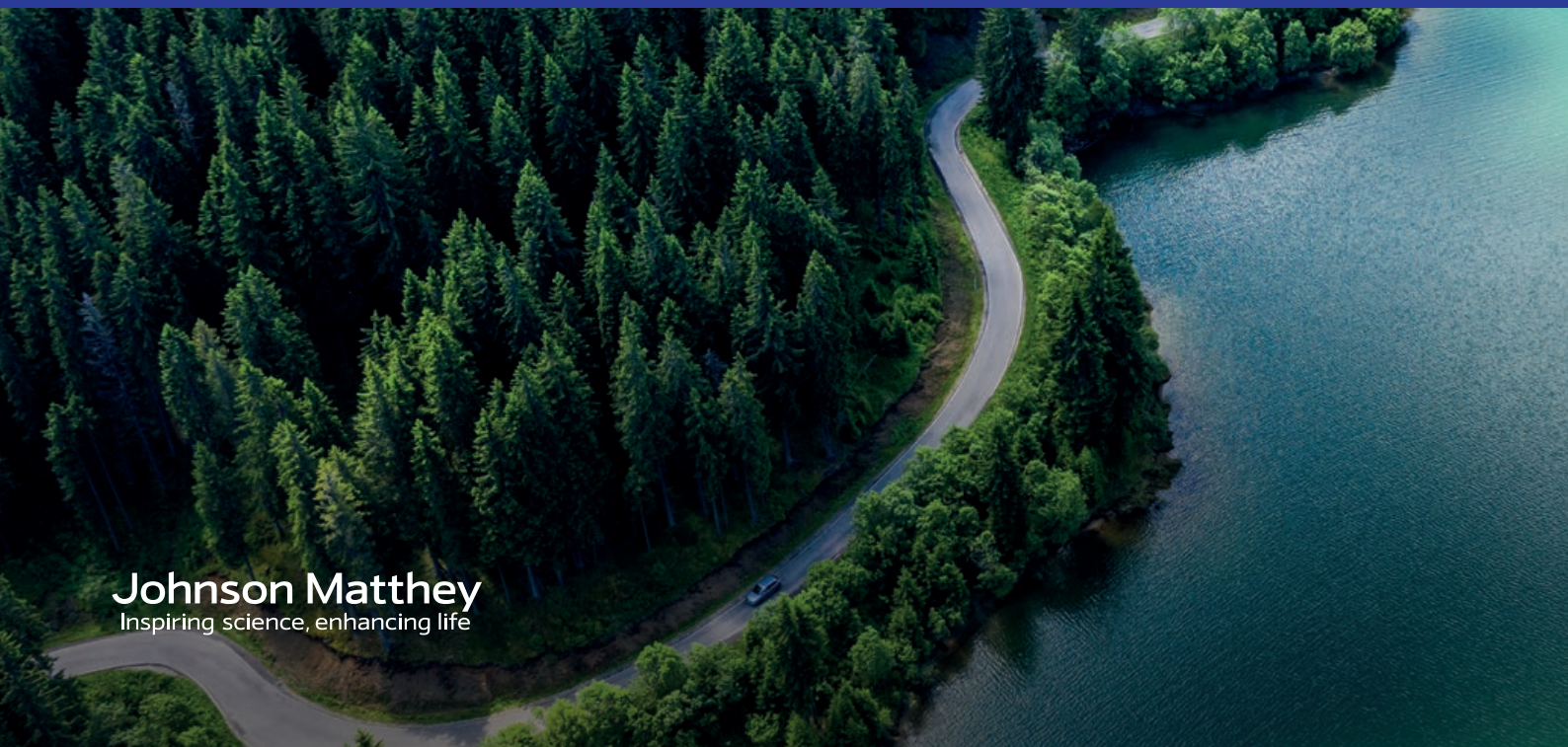
JM

Performance components for PEM fuel cells

Delivering high performing catalyst coated membranes and membrane electrode assemblies



Johnson Matthey
Inspiring science, enhancing life

Fuel cells for decarbonising transportation and energy

Transportation is one of the most significant contributors to greenhouse gas emissions globally, so fuel cells are an attractive solution as societies take action to decarbonise emissions. They use clean or low carbon fuels, such as hydrogen, to generate power electrochemically without releasing any harmful emissions or particulates. Fuel cells have proved ideal for heavy duty and high usage applications, such as for trucks and buses, as they provide the range, low weight and rapid fuelling times required by commercial fleet operators.

Through many years of collaborating with automotive customers globally, our fuel cell technology is already powering fuel cell commercial vehicles across the world. These have already clocked up millions of kilometres of zero emission travel providing invaluable in-field experience and insights to further optimise our products.

The demand for continuous innovation extends beyond automotive. Our fuel cell components also power a range of non-road markets, such as stationary power and materials handling applications.

A collaborative approach to innovation

Our success in developing fuel cell solutions is built on strong, collaborative partnerships. Understanding your systems, challenges and vision for sustainable growth is a vital part of the process. It's this close relationship that helps us deliver innovative fuel cell products that are tuned to meet your specific performance, cost, safety and durability requirements.

At JM, our dedicated development teams are on hand to guide and advise customers along the journey towards a production ready fuel cell system. Through our multi-gigawatt manufacturing footprint we are able to scale products to meet the demand for rapidly growing markets, providing you with competitive products at commercial scale.

In for the long haul

Fuel cell technology dates back almost to when JM began. We supplied the platinum when William Grove first demonstrated a fuel cell in 1839. In the 1960s, we supplied the electrocatalysts during the Apollo space missions. We were the first company to commit to a dedicated membrane electrode assembly (MEA) manufacturing site, which is based in Swindon, UK. More recently, we demonstrated our commitment to supporting global supply chains by signing an agreement with the Shanghai Jiading District to build a new catalyst coated membrane (CCM) production facility. Construction of a 3 GW production facility for the manufacture of proton exchange membrane components is also underway in Royston, UK.

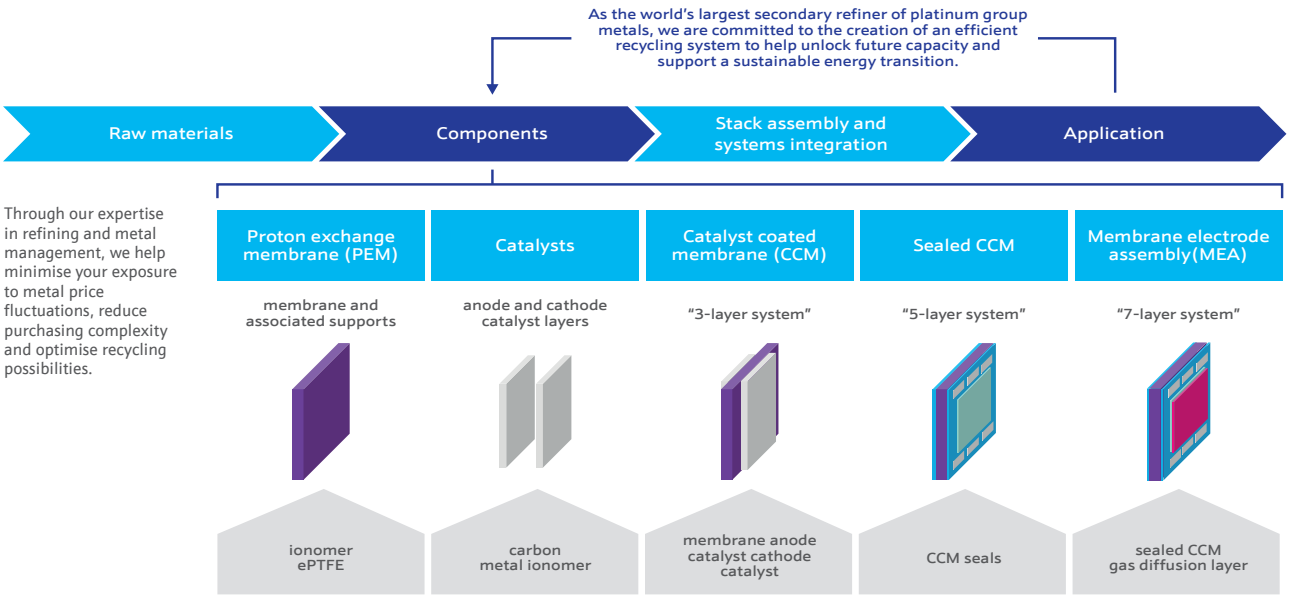
Exceptional science has always been at our core; we have decades of experience in fuel cell development, characterisation, catalysis, electrochemistry and process optimisation – critical to developing next generation fuel cells.

As the technology evolves, so do we. We'll continue to invest in manufacturing capacity and R&D so we can stay ahead of the curve and meet the demands of the future.

Our catalyst coated membranes and membrane electrode assemblies sit at the heart of the fuel cell stack, ensuring exceptional performance and durability.

Proton Exchange Membrane (PEM) fuel cell offer

JM experience in the electrochemical value chain is comprehensive



JM develops and manufactures leading edge membranes in-house for our CCM and MEA products. Our subcomponents deliver optimised and fully compatible products.

Our **HiSPEC**™ range of top tier fuel cell catalysts are the product of decades of research and development. JM's expertise and continued investment has resulted in a portfolio of high performing catalysts.

Because every fuel cell system is unique, providing flexible and tuned 3-layer (CCM) solutions is vital to success. We supply our advanced materials in roll format, making it suitable for direct integration into your existing manufacturing processes.

Whether you require a fully unitised MEA (7-layer with gas diffusion layer attached) or a 5-layer MEA (sealed MEA without gas diffusion layer attached), we'll find a solution that works for you. Picking from our range of subcomponents, developed with specific applications in mind, we're confident we can help you get the best out of your fuel cell system.

Catalyst coated membrane product options

Our catalyst and membrane options enable us to fine-tune the product to meet your application requirements for optimum performance. Exceptional materials science has always been at our core. We leverage our many years of experience in advanced metals chemistry and catalysis to make the most efficient use of precious raw materials, whilst delivering on performance.

Catalyst coated membrane product options		
Anode	Standard platinum product	High durability with next generation CRT technology (Up to 90% lower iridium content[1])
Membrane	JM in-house membrane: 8 µm - 18 µm thickness. External membrane options also available	
Cathode	0.3 – 0.6 mg/cm^2 platinum loading Tuneable to meet specific performance requirements	

Table 1. Our catalyst coated membrane product options are tuneable to customer needs.

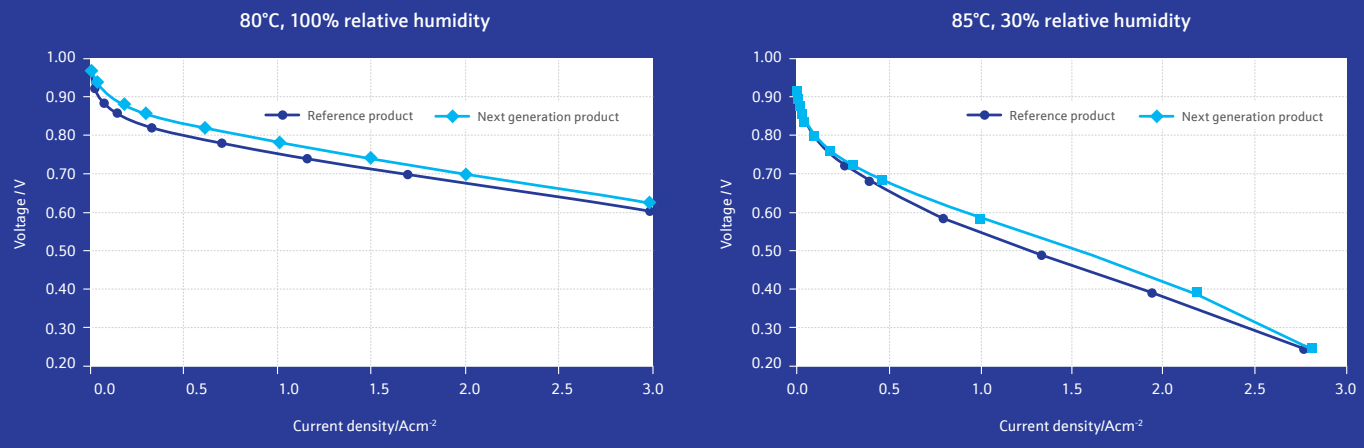


Figure 1. With improved catalysts and catalyst layers we deliver improved performance across a range of conditions, whilst enabling more than a 30% reduction in platinum content. Testing conditions: 12 µm membrane.

[1] When compared to our previous generation CRT technology.

Cell reversal tolerant anode

At JM we recognise the demanding conditions under which heavy-duty automotive fuel cell applications operate. To mitigate the risks that come with freeze starts and transient operating conditions we offer a highly durable cell reversal tolerant (CRT) anode. Our latest CRT anode has been further optimised by reducing the iridium content by up to 90%[1] helping secure the supply of this precious and powerful metal.

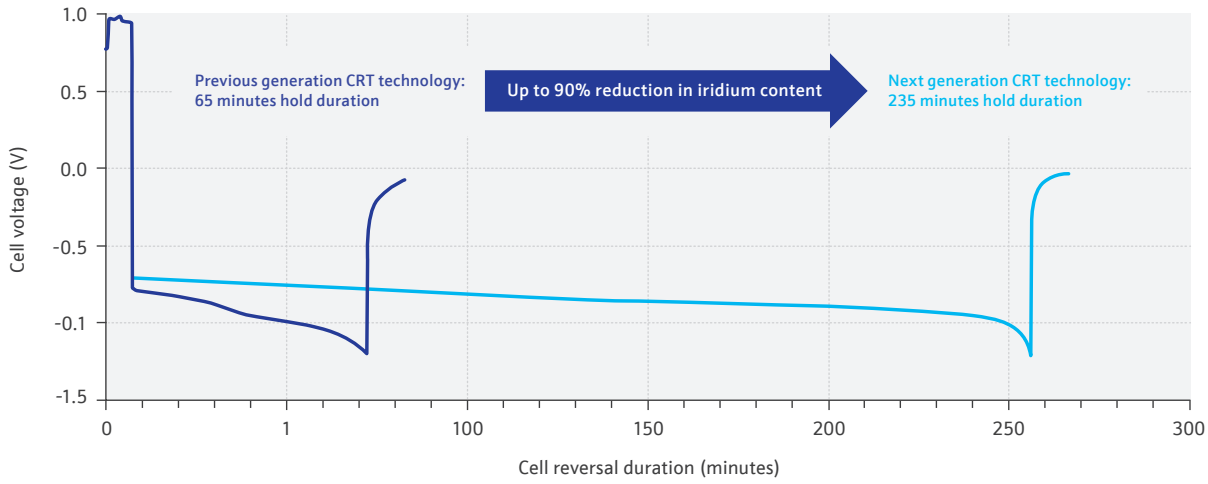


Figure 2. Our CRT technology enables up to 90% reduction in iridium content whilst delivering improved durability, when compared to our previous generation CRT technology. Testing conditions: Continuous reversal at 200 mA cm^{-2}, 60°C, 100% relative humidity, 150 kPa, 1.5/2.0 stoichiometry.

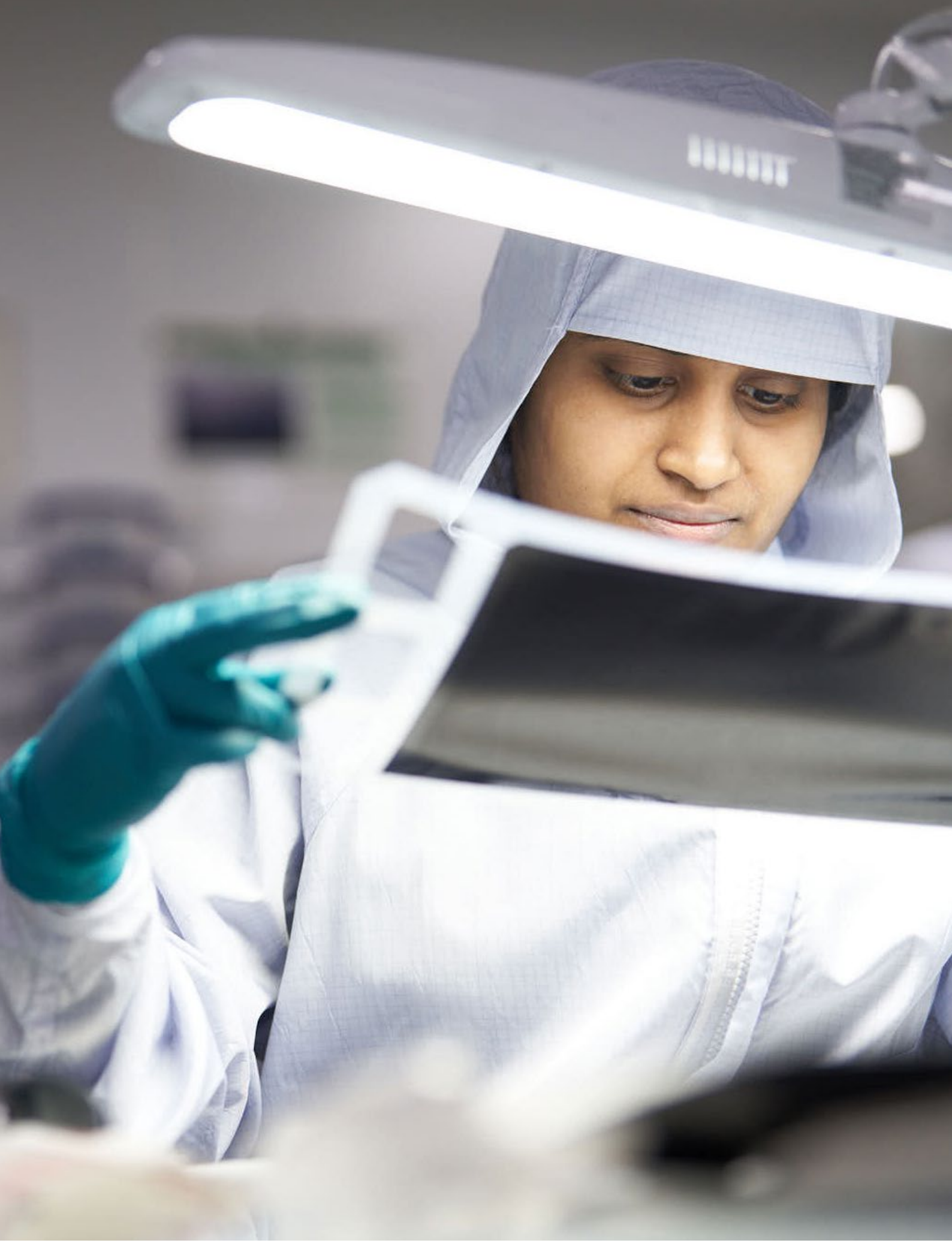
Global manufacturing footprint

Up to 5 GW initial capacity Jiading, China
Planned capacity

5 GW (scaling to 10 GW over time) Location tbd, US
Planned capacity

3 GW, Swindon, UK
Operational

3 GW initial capacity, Royston, UK
Under construction



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