Platinum Group Metals

The unsung heroes of our modern world

Johnson Matthey
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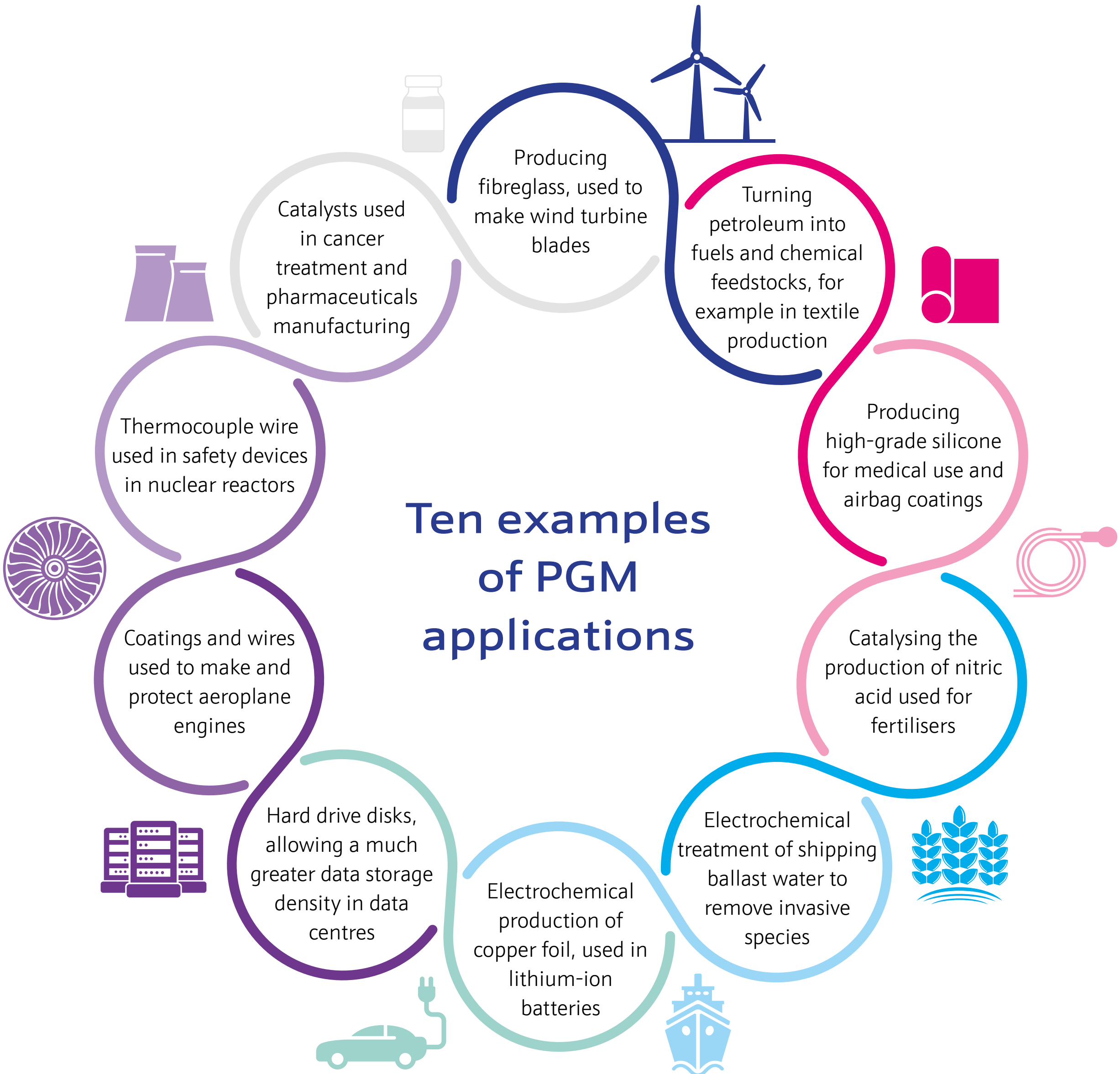
The platinum group metals (PGMs) surround and enhance our daily lives. But you might not even know they're there, or the breadth and scale with which they are needed.

This group of metals, consisting of platinum, palladium, rhodium, ruthenium, iridium and osmium[1], are usually found together in the Earth's crust and are grouped together on the periodic table, indicating their similar properties. It is these properties that set the PGMs apart from other materials, in their ability to deliver enormous benefits in an almost endless list of applications that we depend on, today, and for our future.

They drive sustainability in these applications, enabling good health, climate action and environmental benefits. Their largest application is currently in automotive catalytic converters to control emissions of pollutants from vehicles, but their reach is much wider, playing a critical role in other products and processes. Some interesting examples are included here, with a more comprehensive overview of the many PGM uses given in JM's "**A guide to PGMs**".



But what is it about the PGMs that makes them unique and irreplaceable in so many applications?

[1] Osmium's applications are very niche, so it is not included when we reference the PGMs

PGMs bring powerful advantages that are hard to match

Catalytic activity

PGMs are highly active catalysts, meaning they enable a broad range of challenging chemical reactions to occur at lower temperatures than other catalysts. For over 50 years, the catalytic properties of platinum, palladium and rhodium have been harnessed in catalytic converters for diesel and gasoline vehicles. These metals convert the polluting gasses in an exhaust into less harmful substances, helping to clean the air we breathe.

All five PGMs are important catalysts in industrial applications, where they increase the efficiency and reduce energy consumption in many processes. This includes the production of plastics, fertilisers, pharmaceuticals and petrochemical fuels.

More recently, PGM demand has been rising in the emerging hydrogen economy. PGM catalysts are critical components of proton exchange membrane (PEM) fuel cells for transportation, and PEM electrolysers for renewable (green) hydrogen production. Together, these technologies are unlocking the potential of hydrogen as a sustainable fuel.

Durability

PGMs are highly stable materials. They're able to withstand extremely harsh conditions such as corrosive, oxidising and high temperature environments, which makes them durable in a number of applications that have no alternative. This is particularly apparent in the glass industry, where platinum-rhodium alloys are used to coat and protect glassmaking equipment against the highly corrosive and extreme heat of molten glass used for high quality medical vials, fibreglass, solar panels and phone screens.

In another example, pure iridium crucibles are the only known material that can produce single crystals of various metal oxides, withstanding the required high temperature conditions of around 1,600˚C and above. These crystals are used in surface acoustic wave (SAW) filters which give cellular signal to devices such as mobile phones, as well as in PET scanners for cancer diagnosis.

Mineral efficiency

A little goes a long way in PGM-based technologies. With their high value, this efficiency has always been an intensive focus for the industry. There are ongoing research and development efforts to lower PGM intensity in technologies (known as 'thrifting') so that less is needed to achieve the same performance.

For example, one fuel cell passenger vehicle typically uses around 20g of PGM (and around 40kg of base metal). Despite the relatively high value of the PGMs, this equates to around $600, with the total metal cost per vehicle at around $1,000. Compare this to the amount of base metals used in a battery electric passenger vehicle, around 140kg costing over $2,000, and it is immediately clear that PGMs offer a significantly more efficient use of critical metals.

The efficiency with which PGMs can be used is especially important for our future in navigating the energy transition. To do so successfully will require these powerful metals to be harnessed in clean energy applications to address hard-to-abate sectors.

Circularity

Circularity is already established and works well for the PGMs. With limited quantities of these precious metals occurring naturally in the earth, recycling is driven by their high value and has been widely undertaken from the vast range of industrial applications for decades. This has given rise to a mature, effective and global recycling network for these metals.

Much recycling of PGMs happens in a 'closed loop', where the metal is retained within the application it was purchased for; this substantially reduces the ongoing requirement for primary (mined) metal in various industrial applications. By contrast, PGMs from end-of-life catalytic converters are widely recovered in an 'open loop' – meaning once refined, the metal becomes available to the market for use in other applications.

Recycled PGMs have exactly the same properties as when they are first mined, so they can be reused indefinitely. But they have up to 98% lower carbon intensity. This means that recycled PGMs are a source of supply to serve our technology needs well into the future, while also lowering carbon intensity over time.

The importance of PGMs for our future

The energy transition from fossil-fuel based systems to renewable sources is creating major shifts in existing PGM markets, offering a unique opportunity for new applications of these metals.

The largest current use of PGMs in automotive catalytic converters will decline in the future as internal combustion engines are phased out. At the same time, demand will rise from clean energy applications in new markets, particularly for the hydrogen economy. PGM use in PEM fuel cells and electrolysers is well known, but PGMs will also be needed for hydrogen transport, as well as processing and purification. They are also highly effective catalysts in several stages of producing sustainable fuels and chemicals, generally being used at far lower intensities than equivalent base metal catalysts.

This means that the PGMs face a completely different dynamic from other critical metals: a natural shift in demand from declining use in fossil-fuel-based applications, with energy-transition applications coming in as replacement demand. In comparison, other metals required for the energy transition, particularly for direct electrification and battery electric vehicles, face additional demand to what is already needed. This is likely to create supply-demand gaps that are not easy to bridge, unless PGMs are deployed in complementary technologies to optimise the overall efficiency of the energy system and effectively tackle climate change challenges.[2]

[2] Why critical metals efficiency is essential for the clean energy transition


PARKING

For more information on PGMs and our market research, visit
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