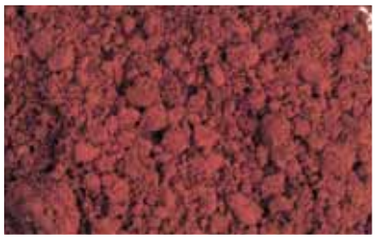
IMPLATS
Distinctly Platinum

The platinum group metals

The six platinum group metals (PGMs) – platinum, palladium, rhodium, osmium, ruthenium and iridium – occur together in nature alongside nickel and copper. Platinum, palladium and rhodium, the most economically significant of the PGMs, are found in the largest quantities. The remaining PGMs are produced as co-products. South Africa is the world's leading platinum and rhodium producer, and the second largest palladium producer after Russia. South Africa's production is sourced entirely from the Bushveld Complex, the largest known PGM-resource in the world.

PLATINUM, a silvery-white metal and the most common and widely used of the platinum group metals (PGMs), is also one of the most precious metals. As with all of the PGMs but especially so in its case, platinum has many unique properties making it ideally suited to advanced technical applications. As one of the densest and heaviest metals known to man, platinum is also extremely durable. It is also very malleable and ductile. Although it has a very high melting point (1,772°C), it is stable at extremely high temperatures. In addition to being resistant to corrosion and chemical attack, it is a very good conductor of electricity, is a powerful catalyzing agent and is recyclable. Platinum is primarily used in the jewellery and automotive industries, with the latter making use of its excellent catalytic properties.

PALLADIUM, together with platinum, is more abundant than any of the other PGMs. Like its sister metal, platinum, palladium has a natural white lustre when polished. It is the lightest and has the lowest melting point (1,554°C) of all the PGMs. Its most remarkable property is its ability to absorb enormous amounts of hydrogen at room temperature. During this process the metal expands and becomes harder, stronger and less ductile, thus making it an efficient and safe medium for the storage of hydrogen and as a purifier. Given palladium's catalytic qualities, it too has a vital role in catalytic converters and in air purification equipment. Its chemical stability and excellent electrical conductivity make it a more effective and durable plating than gold in electronic components. It is most frequently used in alloys or as a catalyst and can be used as a substitute for platinum in jewellery, electrical contacts and catalysts.



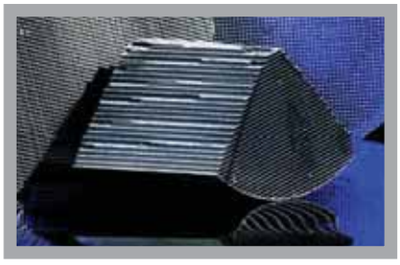
RHODIUM is also a silvery-white metal but has a higher melting point and lower density than platinum. It has a high reflectance and is hard and durable, and is a major component of industrial catalytic systems. Its primary use is in the automotive industry for the reduction of NOx to nitrogen. Rhodium alloyed with other PGMs is used for furnace windings, thermocouple elements, bushings for glass fibre production, electrodes for aircraft spark plugs and laboratory crucibles. Rhodium is useful as an electrical contact material as it has a low electrical resistance, a low and stable contact resistance and is highly resistant to corrosion.

NICKEL, an important by-product of PGM mining operations, is a hard, silvery-white metal that is highly resistant to corrosion. It is used extensively in coins and is a vital ingredient in the production of stainless steel. The stainless steel industry consumes approximately two thirds of nickel supply with the balance being used either in alloys or for electroplating.

and their applications

Many of the unique physical and chemical characteristics of PGMs make them indispensable to modern technology and industry, and their markets are many and varied, from the automotive industry to the medical field where platinum is used as a potential cure for Parkinson's disease. Their catalytic properties – particularly those of platinum, palladium and rhodium – make them ideally suited to many applications aimed at countering the effects of air pollution and limiting the production of greenhouse gases. Another distinctive characteristic of PGMs is that they are recyclable.

AUTOCATALYSTS: Catalytic converters are honeycomb-like structures made of either metal or ceramic material consisting of hundreds of minuscule channels coated with platinum and/or palladium as well as rhodium. The honeycomb-like structure enables the maximum volume of exhaust gas produced by the engine to be exposed to the catalyst, which in turn acts to remove noxious pollutants from the exhaust gas. This, the catalytic convertor does by converting more than 95% of the hydrocarbons, carbon monoxide and nitrous oxides produced by motor vehicle engines to less harmful carbon dioxide, nitrogen and water vapour. In the European Union, the use of catalytic convertors has helped, together with cleaner fuels, to contribute to a 98% reduction in vehicle emissions. More than half of all the cars on the roads around the world and more than 90% of new vehicles are fitted with autocatalytic convertors. Today, demand for PGMs from the automotive industry is significant and growing, underpinned by ever-more stringent legislation in the USA and Europe and burgeoning auto markets in China and India.



JEWELLERY: Jewellery has been a key driver of overall platinum demand over the past decade. Given platinum's high degree of purity, the jewellery does not fade or tarnish and it is non-allergenic. The platinum jewellery market first took off in Japan and has in recent years become increasingly significant in China. Aside from its aesthetic qualities, platinum's strength, hardness and density make it a safe setting for diamonds and other precious stones. Being non-allergenic and oxidation resistant also makes it an ideal medium for jewellery. Platinum is sometimes combined with other PGMs to enhance its various properties; as an alloy with iridium its brilliance is enhanced. Platinum is combined with palladium to improve its softness and ductility in chain making, and with ruthenium to improve its machining properties in high-volume manufacturing.

INDUSTRY AND TECHNOLOGY: Platinum and palladium have a multitude of uses in industry. In the chemical industry, the largest consumer of PGMs is for platinum-based catalysts, which in recent years have included rhodium as well, for the commercial production of nitric acid, an essential ingredient in nitrogen fertiliser.

Another major source of demand, for platinum and especially palladium, is in dental applications. These metals are combined with gold and silver to produce alloys suitable for dental inlays, crowns and bridges.

In the electronics industry, a major use of palladium is in the coatings in multi-layer ceramic capacitors (MLCC) which store electric energy in the form of an electrostatic field. These devices are used in broadcasting equipment, mobile telephones, computers, electronic lighting and high-voltage circuits among others. Palladium is also used in the connectors in hybrid integrated circuits and inside computers while magnetic platinum-cobalt alloys are vital components of computer hard disks, enabling a substantial increase in their storage capacity.

PGMs combine to make platinum and palladium alloys of exceptional hardness and durability, making them the best coating for industrial crucibles which are required to withstand extremely high temperatures in the manufacture of chemicals and synthetics. Their purity is also important in these processes as they do not lead to contamination. In particular, platinum alloyed with rhodium is used in the crucibles for the production of high-quality glass such as liquid crystal display glass as well as fibreglass.

The petroleum industry also makes use of PGMs and their unique properties. Platinum is used in a process to upgrade the octane content of gasoline called catalytic reforming. Palladium is used in hydrocracking, a process to increase the yield of gasoline, and in isomerisation, a lesser used but more specific version of reforming

Sources: *International Platinum Association, Platinum Guild International, Encyclopaedia Britannica, Johnson Matthey*