



Palladium

Autocatalyst

In 2003 purchases of palladium by the global autocatalyst industry improved by 13 per cent to 3.46 million oz, an increase of 410,000 oz compared with 2002. The recovery in purchases was almost entirely due to the fact that, having largely run down very sizeable palladium inventories in 2002, the US auto industry sourced the majority of its palladium from the market last year. However, the underlying use of palladium on autocatalysts in the USA dropped significantly as thrifting programmes cut average palladium loadings.

In Europe, purchases of palladium fell due to a slump in sales of gasoline powered cars, primarily a result of another strong rise in diesel car market share. Japanese autocatalyst purchases of palladium improved moderately but demand in the Rest of the World was hit by continued thrifting in many markets and a steep fall in Mexican light vehicle production.

Europe

European demand for palladium in autocatalysts dropped by 12 per cent in 2003 to 1.21 million oz, down from 1.37 million oz the year before. The primary cause was a substantial fall in sales of gasoline powered cars; diesel cars gained further market share and total car sales in the region weakened. Sales of gasoline cars slumped by 11 per cent, falling below 8 million units for the first time in over a decade. The market share held by gasoline cars in Western Europe slipped to less than 57 per cent – five years ago that figure was around 75 per cent. With the ratio of palladium to platinum use in gasoline autocatalysts close to 4:1 on average in Europe, the drop in gasoline vehicle sales had a marked effect on demand for palladium.

Thrifting also had a negative impact on purchases of palladium by European auto makers in 2003; average palladium loadings fell by around 4 per cent across the gasoline vehicle fleet as a whole as some manufacturers continued to focus on minimising their overall pgm use. In addition, decisions taken in 2000 and 2001 by several car companies to reduce palladium use in favour of platinum continued to adversely affect demand for the former in 2003, although the impact was less than the year before.

With palladium trading at a widening discount to platinum throughout 2003, some manufacturers

moved to reverse the process of switching, aiming to cut future platinum usage on gasoline vehicle models through greater reliance on palladium. In the short-term, however, further thrifting of palladium loadings and growth in the market share taken by diesel cars will more than offset any increase in palladium use.

Japan

Car companies in Japan purchased 540,000 oz of palladium in 2003, an increase of 4 per cent (20,000 oz) compared with 2002. Palladium purchases rose largely because Japanese manufacturers used little or no metal from inventories in 2003, whereas there had been some use of stocks in 2002. Car sales increased by 1.5 per cent in Japan in 2003 but car production weakened, a reflection of the fact that a growing proportion of vehicles manufactured by Japanese car companies is being produced overseas.

The underlying use of palladium in autocatalysts in 2003 slipped lower as thrifting reduced average palladium loadings modestly. This fall is likely to be reversed in 2004. Certain manufacturers plan to shift overall pgm ratios more towards palladium than platinum, whilst average loadings are forecast to edge upwards in advance of the next phase of Japanese vehicle emissions legislation, due in 2005. The combined effect on metal demand, however, is expected to be fairly small.

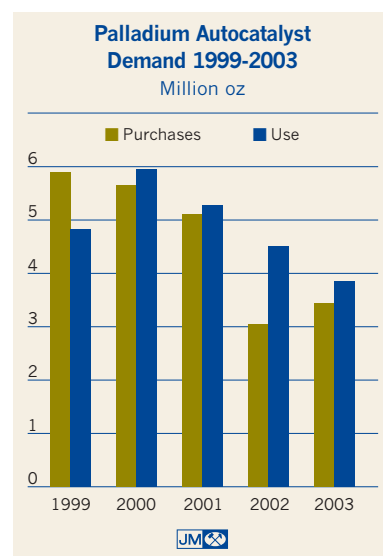
North America

North American vehicle manufacturers purchased 1.21 million oz of platinum in 2003 – almost double the volume bought in 2002, when demand for new metal was heavily suppressed by the use of an estimated 1.4 million oz of metal from inventories. Certain auto companies continued to run down their remaining palladium stocks in 2003 but purchased a much greater proportion of their metal requirements from the market.

This, however, has to be set against a substantial fall in the underlying use of palladium in autocatalysts in North America, which dropped by more than 20 per cent in 2003. The decline was a result of the intensive thrifting of palladium loadings that was achieved by catalyst manufacturers, prompted by pressure from US auto makers following the palladium price spike in 2000 and 2001.

Changes in autocatalyst pgm ratios in response to the large differential between the price of platinum and

	2002	2003
Europe	1,370	1,210
Japan	520	540
North America	640	1,210
Rest of the World	520	500
Total	3,050	3,460
Autocatalyst recovery	(370)	(410)





Palladium



The manufacture of vinyl acetate monomer is a major application for palladium-based catalysts, and capacity in Asia expanded in 2003.

palladium started to emerge in 2003, with US auto makers in the vanguard of moves to replace platinum-rhodium catalysts with platinum-palladium-rhodium or palladium-rhodium products. That said, the process of catalyst change is evolutionary and the impact on use of palladium last year was slight.

Rest of the World

Demand for palladium used in autocatalysts in the Rest of the World dropped by 4 per cent (20,000 oz) in 2003, easing to 500,000 oz. A 14 per cent decrease in light vehicle production in Mexico had a significant impact on autocatalyst demand for palladium. Mexican vehicle output fell from over 1.7 million units to around 1.5 million due to a combination of poor domestic sales (which were hampered by the weak economy) and lower exports to the USA.

At the same time, thrifting of palladium reduced average loadings in autocatalysts produced in Mexico and elsewhere. The negative effect of this outweighed the positive impact of higher car production in China, India and several other countries in Asia.

Autocatalyst Recovery

The volume of palladium recovered from scrapped autocatalysts climbed by 11 per cent to 410,000 oz in 2003. As with platinum, the growth in the rate of recovery was greatest in Europe (up by 56 per cent to 70,000 oz) as the percentage of scrapped cars fitted

with catalytic converters increased and greater efforts were made to remove and recycle catalysts.

The rise in the rate of recovery of palladium from autocatalysts in North America, where the auto recycling industry is more mature, was far more modest (up by 4 per cent to 270,000 oz). A substantial increase, however, is forecast for 2004 and beyond as greater numbers of vehicles with heavily loaded palladium catalysts (manufactured from the mid-1990s onwards) reach the end of their lives.

Chemical

Purchases of palladium for use in bulk chemical manufacturing applications softened slightly in 2003, easing to 250,000 oz. Demand for palladium from the nitric acid industry improved moderately, helped by lower metal prices, but demand from the process catalyst sector fell in Europe and North America.

The fall in the price of palladium and the strong rise in the price of platinum made the use of palladium catchment gauze more cost-effective for nitric acid producers in 2003. In addition, some manufacturers shifted from 5Rh/95Pt catalyst alloys (5 per cent rhodium, 95 per cent platinum) to 5Pd/5Rh/90Pt alloys (adding 5 per cent palladium in place of platinum). However, producers' costs and margins were under severe pressure for much of the year and investment in replacement catalysts and catchment gauzes was generally kept to a minimum. As a result, palladium demand increased by only a few thousand ounces.

In the process catalyst sector, expansion of manufacturing capacity for bulk chemicals produced using palladium catalysts continued in Asia, with new vinyl acetate monomer (VAM) and purified terephthalic acid (PTA) plants coming on stream. This was offset, however, by reductions in manufacturing capacity for PTA and hydrogen peroxide in Europe and North America.

Dental

In 2003 demand for palladium from the dental alloys market fell by 8 per cent to 725,000 oz. Demand for palladium-based alloys had been expected to continue to recover from the recent low of 2001 in response to the fall in the price of the metal. However, in the largest market, Japan, a reduction in the level of government subsidies available for dental treatment led to a sharp drop

Palladium Demand: Chemical '000 oz		
	2002	2003
Europe	70	65
Japan	20	20
North America	75	70
Rest of the World	90	95
Total	255	250





in palladium alloy demand. This overshadowed improvements in the European and North American markets.

In Japan, the cost of the 20 per cent palladium alloy (kinpala) used in dental treatment is heavily subsidised by the government. In April 2003, however, the percentage of the cost that is reimbursed by the state-run programme was cut from 80 per cent to 70 per cent. This was the second reduction in the level of state subsidies in four years. The subsequent rise in treatment costs payable by patients resulted in an immediate and substantial drop in the number of visits to dentists, with people keen to postpone treatment for as long as possible. The knock-on effect on kinpala alloy demand was rapid and severe, which in turn resulted in purchases of palladium for alloy manufacture dropping by 20 per cent to just 405,000 oz – the lowest level for more than a decade. Demand is expected to improve in 2004 as the number of dental procedures undertaken starts to pick up but the recovery is likely to be slow.

European demand for palladium in dental alloys improved in 2003, rising by 15,000 oz to 70,000 oz. In most countries the substitution of palladium with alternative alloys and porcelain products appears to have been permanent. The exception is Italy, where use of precious metal dental alloys has remained relatively high. In Italy, the fall in the price of palladium coupled with the rise in the price of gold resulted in a

move away from high-gold alloys back towards palladium-based formulations.

The lower price of palladium and higher cost of gold also encouraged a recovery in demand for the former in the North American dental market. Purchases of palladium climbed by 9 per cent to 235,000 oz as high-gold alloys lost market share. Should the price of palladium remain at a significant discount to that of gold throughout 2004, further modest growth in palladium demand can be expected.

Electronics

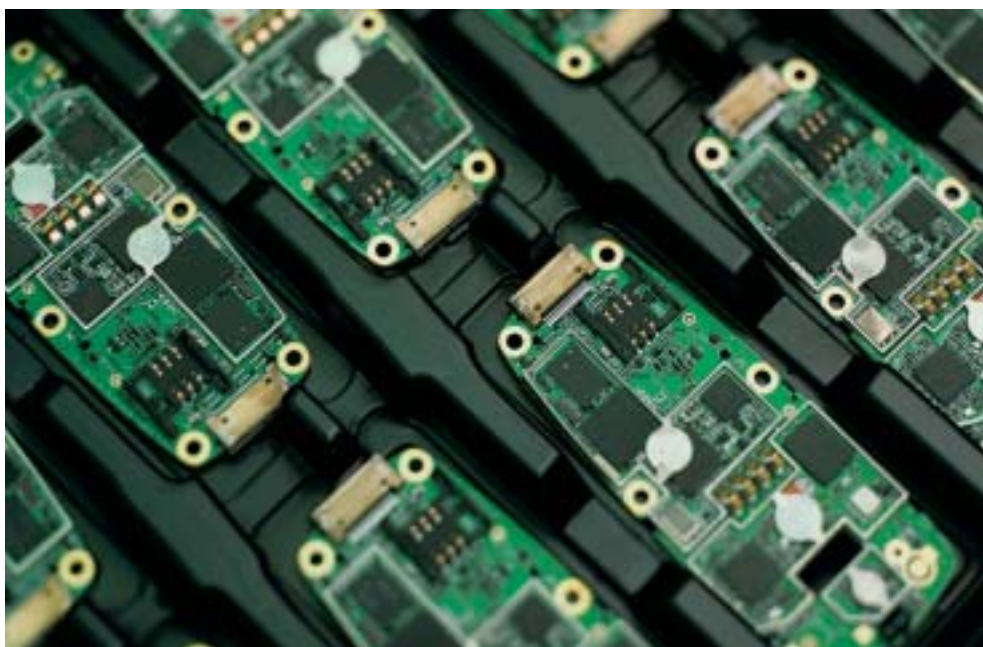
The use of palladium in the production of electronic components fell by 7 per cent in 2003. The decline in consumption was due to a combination of the ongoing miniaturisation of capacitors and hybrid integrated circuits, and further thrifting of precious metal use throughout the industry. Purchases of palladium, however, by manufacturers of electronic components recovered by 18 per cent in 2003 to 895,000 oz. Metal demand more closely reflected the level of component orders as excess inventories, which had depressed purchases of palladium in 2002, had been depleted by the beginning of 2003.

Multi-layer ceramic capacitors (MLCC) remain the largest electronics application for palladium. Shipments of MLCC grew by almost 18 per cent in 2003, rising to approximately 600 billion compared with

Palladium Demand: Dental '000 oz		
	2002	2003
Europe	55	70
Japan	505	405
North America	215	235
Rest of the World	10	15
Total	785	725



Palladium Demand: Electronics '000 oz		
	2002	2003
Europe	85	85
Japan	140	220
North America	210	215
Rest of the World	325	375
Total	760	895

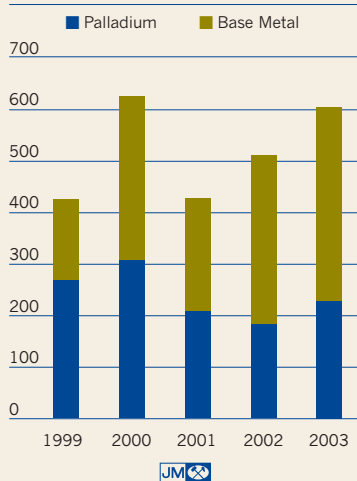


The ongoing miniaturisation of electronic components resulted in a fall in the consumption of palladium in the manufacture of multi-layer ceramic capacitors in 2003.



Palladium

**MLCC Production by Electrode Type
1999-2003**
Billions



Data Source: Paumanok Publications, Inc.

a little over 500 billion the year before. The surge in component orders was based on a combination of rising demand for mobile phones, personal computers and automobile electronics, with the Chinese market for consumer goods growing particularly rapidly.

The output of palladium-based MLCC grew slightly faster than the sector as a whole, rising by 21 per cent in 2003. The erosion of palladium MLCC market share by nickel-based capacitors reached a plateau in Japan (by far the largest centre of production) and was reversed somewhat in China as new production capacity for palladium MLCC came on stream. This did not, however, result in greater use of the metal. On the contrary, consumption of palladium actually fell marginally year-on-year due to a combination of miniaturisation and thriftiness.

The average size of MLCC has been declining for many years and this global trend accelerated in 2003 with the introduction of a new generation of products. These capacitors are approximately 70 per cent smaller in volume terms than their predecessors, and so contain substantially less palladium. Rapid uptake of these smallest capacitors is expected in the mobile phone industry; the pressure to fit more components into a given volume is becoming more intense as phone functionality expands. In addition, MLCC manufacturers continued to thrift their use of palladium in 2003. The average palladium content of conductive pastes used by the industry has fallen from around 30 per cent to 20 per cent since 1998.

Thriftiness also affected demand for palladium in hybrid integrated circuits (HIC) in 2003. Component manufacturers have successfully reduced their palladium consumption substantially since the price of the metal peaked in early 2001. In addition, the market share taken by palladium-free HIC has expanded. Consequently palladium use in HIC production slumped by 35 per cent in 2003.

Demand for palladium in the plating of lead frames and connectors increased in 2003 as the price of palladium fell significantly below that of gold. The rise in demand was marginal, however, due to continued miniaturisation of components and further reductions in precious metal use through the application of thinner coatings.

Demand for line feed resistors (also known as surge protection resistors) increased only slightly in 2003 – a key application for these resistors is telecommunications infrastructure and a significant recovery in

activity did not materialise as expected. On a more encouraging note, good demand for varistors and actuators containing palladium was seen from the automotive and mobile phone sectors.

Other

Purchases of palladium by the jewellery fabrication and other industries weakened by 3 per cent in 2003, slipping to 340,000 oz. Demand from the Japanese jewellery industry edged lower as demand for platinum alloys containing palladium fell and recycling of inventories grew. Demand from the Chinese jewellery sector also softened, with other metals increasingly used in place of palladium in white gold alloys. Use of palladium in most other applications was stable.

Purchases of palladium for use in jewellery alloys dropped by 10,000 oz to 250,000 oz in 2003. Japan accounted for approximately two thirds of total palladium jewellery demand; platinum alloys containing 5 to 15 per cent palladium are preferred by many Japanese fabricators. Consequently, the drop in retail sales of platinum jewellery and the increased volumes of metal recycled throughout the industry in 2003 depressed demand for palladium. The effect was lessened somewhat by an increase in production of white gold jewellery, in which palladium can be used as a whitening agent.

Palladium is also a constituent of some platinum and white gold jewellery alloys produced in China, although alternatives are much more commonly used than in Japan. The fall in platinum jewellery output in China in 2003 and the increased use of metals such as nickel, zinc and tin in white gold alloys resulted in demand for palladium softening, despite rising retail sales of white gold jewellery.

Demand for palladium-based hydrocracking catalysts from the worldwide petrochemicals industry was stable, maintained by top-up orders from existing installations. Hydrocracking capacity is expanding in North America as a result of legislation to lower the sulphur content of gasoline but operators have generally preferred to install less expensive base metal catalysts in new plants.

The use of palladium in other minor applications such as brazing alloys, catalysts for stationary emissions control applications, and photographic film was broadly unchanged in 2003.

Palladium Demand: Jewellery & Other
'000 oz

	2002	2003
Europe	50	55
Japan	175	170
North America	45	40
Rest of the World	80	75
Total	350	340

