

GOING FOR PLATINUM

By Neala Williard



over \$850. The same troy ounce of gold was worth about \$425. You have to ask: what makes platinum twice as valuable as gold?

Supply and demand

It's a classic case of economics. Worldwide, the demand for platinum has exceeded the supply for each of the past five years. As a result, the price of platinum increased. For example, in 2003, the worldwide

demand for platinum was 6.5 million ounces. The supply that year was 6.2 million ounces. Clearly, the demand for platinum is growing and may continue to grow for many years. The explanation for that demand is complex, involving both the unique properties of platinum and the new uses that extend its popularity beyond the jewelry counter.

Platinum in cars

Look at the design of today's cars, and you'll find that platinum has a hard-working side that goes well beyond its beautiful face. Inside a catalytic converter—a honeycomb-

shaped ceramic structure near the exhaust manifold—platinum, plated on 900 cells per square inch, goes to work as a catalyst. A catalyst, you probably recall, is a substance that speeds up a reaction without being consumed in the process.

Platinum enables a catalytic converter to perform both oxidation (losing electrons) and reduction (gaining electrons) reactions as it removes dangerous emissions from fuel exhaust.

If we could achieve perfect and complete combustion inside the cylinders of an automobile, the fuel and air would be converted almost entirely to nitrogen gas (N_2), carbon dioxide (CO_2), and water vapor (H_2O)—three mostly benign natural components of the atmosphere (although CO_2 is recognized for its greenhouse gas effects).

But combustion is almost never perfect, and harmful emissions like carbon monoxide, volatile organic compounds, and various nitrogen oxides are often produced. These can react in sunlight to form ozone, smog, and acid rain.

Although Olympic athletes still go for the gold, recording artists like Britney Spears and Garth Brooks measure success by reaching beyond mere gold to platinum—and even beyond that to multiplatinum, when album sales surpass \$2 million.

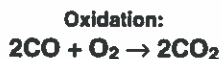
Throughout human history, wealth has often been associated with acquiring, displaying, and wearing gold. King Solomon built a temple and overlaid the entire inside with gold. And, until about 30 years ago, every dollar in your wallet represented a fraction of a gold bar in Fort Knox. So when did platinum take over as the precious metal of choice?

Five years ago, the price of platinum was about \$400 per troy ounce. About 10% heavier than a standard ounce, a troy ounce is used to measure precious metals. At the start of 2005, 1 troy ounce of platinum sold for

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JEWELRY FROM THE GALVAN COLLECTION

Catalyzed by platinum, inside the converter, these emissions undergo second-chance reactions to yield more acceptable exhaust products:



Catalytic converters can only be described as heroic! In 1960, average cars polluted the air with 100 grams of carbon monoxide, nitrous oxides, and hydrocarbons per mile. The use of catalytic converters on modern automobiles has succeeded in reducing the amount of pollutants in automobile exhaust per mile driven to about 2% of what it was before their introduction. But that breakthrough did what no jewelry fashion alone could do. Catalytic converters made platinum a very valuable metal—one far more precious than gold.

Fuel cells, computers, and teeth

Where else will you find platinum? A recent use of platinum is in fuel cells. These cells combine hydrogen (the fuel) and oxygen from the air over a catalyst such as platinum to generate electric power. Daimler Chrysler has 40 vehicles in use by customers worldwide. With a top speed of 85 mph, even highway driving is possible. Cost is the next hurdle for fuel cells.

Computer hard disks use platinum for increased memory capacity. Hard disks are made of aluminum or glass and coated with a cobalt alloy to increase magnetic properties. The magnetic layer stores data in a series of circular tracks. The amount of data stored in a given area depends on the strength of the magnetic field. Adding platinum to cobalt enhances the magnetic qualities enabling higher-density data storage and improved access times.

The dental industry uses platinum or palladium in crowns, bridges, and

inlays. Heart pacemakers contain a platinum/osmium alloy. Many chemistry labs use platinum wires and crucibles. 3M's Post-it Notes stick because of a silicon adhesive formed by a platinum catalyst.

Jewelry

Platinum vs. gold is a decision that ranks right up there with all of the others in the average couple's wedding plans. It's a pricey detail, make no mistake about that! Go with platinum, and that narrow band costs about \$850; go with 14K (carat) gold, and you can reduce the price to about \$250. And that's for the band alone. Diamonds are another story!

Mike Young, vault manager at Hoover and Strong, a gold and platinum refinery, works with plat-

Fact: *Aqua regia or "kingly water" has a special ability. It dissolves gold and platinum! This metal dissolving "water" is actually a one-to-three mixture of nitric and hydrochloric acids. Take our word for it—this isn't something you want to test with your jewelry!*



MINING

Where does platinum come from? If you are holding out hope that someday you'll come across a nugget of pure platinum, don't hold your breath. In nature, platinum is found mixed with other metals. Your best hope is to find a platinum alloyed nugget.

At Kondyor in the Far East in Russia, the recovery of egg-sized nuggets is common. The largest nugget so far weighed 3.52 kilograms, with a metal content worth \$100,000 at today's prices. Approximately 15% of the world's supply of platinum comes from Russia. Most of the time, however, getting platinum is a long and labor-intensive process. Platinum mines operate in Russia, Zimbabwe, Canada, and Montana, but about 72% of all platinum comes from Africa. In South Africa, miners use hand-held pneumatic drills to bore holes and then fill them with explosives. It's a messy and inherently dangerous job that yields just a single ounce of platinum from 7 to 12 tons of ore. The mining process includes crushing the ore, combining it with water and special reagents that cause a desirable mineral mixture to float on frothy bubbles. The skimmed froth yields a mixture with a concentration of 100 to 1000 grams of platinum group metals per ton. Further processing by heat and then electrolysis removes unwanted sulfur, iron, copper, nickel, and cobalt. Obtaining pure platinum from the leftover mix was traditionally done by dissolving it in aqua regia and precipitating the platinum with ammonium chloride. These days, the final refining processes include a complex series of extractions and distillations. Refined purity is over 99.95%.



inum. Hoover and Strong collects scrap jewelry and refines the metal to its pure state. In a procedure called Lost Wax Casting, Mike pours wax into a ceramic mold in the shape of a ring or other platinum piece. He then pours the liquid platinum into this wax mold to form platinum jewelry.

Beyond its obvious beauty, platinum is appreciated by jewelers for its properties.

The PLATINUM Breakdown

Take a look at the periodic table, and you'll notice that platinum is close to five other metals: ruthenium, rhodium, palladium, osmium, and iridium. The six metals are known as platinum group metals. They are rare, chemically similar, and often found together in the earth with copper, silver, and gold. They are thermally stable and do not oxidize in air. Platinum was once thought to be inert, but metallic platinum has been found to catalyze more than 70 reactions. Indeed, the platinum group metals' ability to loosely bind organic molecules has made them valuable catalysts for systems like a car's catalytic converter. Platinum, iridium, and osmium are also the densest known metals. Platinum is 11% denser than gold. Platinum is available in many forms, including foil, sheet wire, insulated wire, gauze, powder, sponge, and mesh.

If you like facts and stories about the elements, *Chemical & Engineering News* has posted 89 essays on its website. Don't expect an encyclopedic recitation of facts—eminent scientists and writers wrote many of the essays about their personal experiences with a particular element or elements. They are available as a linked periodic table at <http://pubs.acs.org/cen/80th/elements.html>. And yes, there's an article on platinum.

Good "ring-quality" platinum is 95% Pt alloyed with other metals (Cu, Ti, Pd, Rh, Ru, Ir, and Os). It melts at 1982 °C (pure Pt 1768 °C), while gold melts at a lower 1149 °C. As a result, Eric Clemente, a gold and platinum smith at Bailey's Jewelry in Raleigh, NC, remarks that he wears welder's goggles as he fashions platinum into rings. Clemente says, "Working with platinum is like starting over as a smith. The process takes two days, but the finished product is



In many cars, the catalytic converter uses a honeycombed structure (shown above) coated with platinum and other precious metals.

brilliant!" He explains that denser platinum requires more precision than gold. But he thinks that platinum rings are desirable because of their substantial weight and durability. What's more, the strong metal allows a precious stone to be secured with a single shank—a feature that

allows the designer more styling options.

Some jewelers try to capture the look of platinum with "white" gold. White gold is actually an alloy made of yellow gold mixed

with other metals such as nickel, palladium, or and/or silver. The product really isn't white, but more "gray-white" in color. It is sometimes plated with rhodium, which gives it a brighter, whiter appearance, but this plating can wear away with time, resulting in the need for replating. White gold can be scratched relatively easily and can lose its luster over time. A true platinum finish can last for many years with only occasional gentle buffing. This has led many consumers to look past price and go for the platinum! ▲

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