

# Know Your Precious Metals Before Investing In Metals

**Written By Simon Newcombe**  
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## Bullion: Mass Of Precious Metals

Bullion is a mass of any one of the known precious metals. By strict definition, precious metals are those metallic elements that are rare. Bullion is commonly made of either gold or silver. Its value is determined by the worth of the metal rather than by its face value as money. To put it another way, bullion is valued based on the mass and purity of the metal used, instead of its artificial currency value.

New sources of ore have been discovered and there also have been improvements in the mining and refining processes. These two factors may cause the values of gold, silver, and the other precious metals to diminish. Also, the "precious" qualification of a metal is determined by the market value or high demand.

Bullion is traded on commodity markets in two forms: bulk ingots or coins, the latter minted by the government of a country. At least ten countries are known to mint gold and silver bullion coins. These are Australia, Austria, Canada, China, Mexico, Poland, South Africa, Switzerland, the United Kingdom, and the United States.

While bullion coins are issued as legal tender, with nominal values assigned to them on minting, such face values are far below the commodity value of the metals themselves. Here's an example: Most of the gold coins issued by national governments, particularly those with currency values of between 10 and 100 U.S. dollars, usually contain no less than 31 grams of gold. On the average (considering the consistent rise in the exchange rate of gold), the value of gold is around USD12 per gram. Here, it is clear that the currency value assigned by the government to a gold bullion coin has no meaning.

Below is a list of some of the government-issued gold and silver bullion coins:

1. Australian Gold Nugget, Lunar Series I, and Lunar Series II
2. Austrian Philharmoniker
3. Canadian Maple Leaf
4. Chinese Gold Panda
5. Mexican Centenario, Libertad, and Onza
6. Polish Orzel bielik
7. South African Krugerrand
8. Swiss Vreneli
9. British Britannia and Sovereign
10. American Buffalo, American Eagle, and Double Eagle

The 10,000-dollar Australian Gold Nugget is one of the world's largest bullion coins. Minted by the Australian government, this bullion coin is made of 1 kilogram of 99.9% pure gold. Some other bullion coins larger than the Australian Gold Nugget have come out. However, these are not produced in mass quantities and are not practical to handle. Two examples are given here: One is the 100,000-euro Vienna Philharmonic, minted in 2004, which contains 31 kilograms of gold; the other is the 1 million-dollar Canadian Maple Leaf, minted in 2007, which contains 100 kilograms of gold.

Three factors - metal, purity, and weight - affect the value of bullion. The overall value of bullion is determined by the metal used. We know, of course, that platinum is worth more than gold, which, in turn, is worth more than silver. It is easy to understand, therefore, that silver bullion coins have become popular with collectors because of their relative affordability.

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## Gold: Most Sought-After Precious Metal



Of all the different precious metals we can think of, gold is certainly the one most greatly desired. Since the beginning of recorded history, gold has been in use in many different works of art, coinage, and, of course, jewelry. Occurring as grains in rocks and in alluvial deposits, gold is shiny, soft, and dense. It is known to be the most ductile and malleable pure metal.

What makes pure gold especially attractive is its bright yellow color and luster.

These characteristics are maintained as gold is chemically unaffected by air or moisture. Here are some of the properties of gold:

### **General:**

- Chemical Symbol: Au
- Atomic Number: 79
- Category (as an element): Transition Metal
- Group/ Period/ Block (in the Periodic Table): 11/ 6/ d
- Atomic Weight: 196.966569(4) g.mol<sup>-1</sup>
- Electron Configuration: [Xe] 4f<sup>14</sup> 5d<sup>10</sup> 6s<sup>1</sup>

### **Physical:**

- Density (near room temperature): 19.30 g.cm<sup>-3</sup>
- Liquid Density (at melting point): 17.31 g.cm<sup>-3</sup>
- Melting Point: 1064.18°C, 1947.52°F, 1337.33°K
- Boiling Point: 2856°C, 5173°F, 3129°K
- Heat of Fusion: 12.55 kJ.mol<sup>-1</sup>
- Heat of Vaporization: 324 kJ.mol<sup>-1</sup>

### **Atomic:**

- Oxidation States: -1, 1, 2, 3, 4, 5
- Electronegativity: 2.54 (Pauling scale)
- Atomic Radius: 144 picometre
- Covalent Radius: 136±6 picometre
- Van der Waals Radius: 166 picometre
- Ionization Energies: 890.1 kJ.mol<sup>-1</sup> (first), 1980 kJ.mol<sup>-1</sup> (second)

The term "gold" was derived from "geolu", an Old English Anglo-Saxon word which means "yellow". Its symbol "Au", on the other hand, originated from "aurum", the Latin word for "gold". The exact period when gold was first discovered could be a subject of dispute. While some accounts point to the year 1848 when gold was discovered in California, history tells us that this precious metal was already being used extensively by the ancient Egyptians, Romans, Greeks, Chinese, and South Americans.

Throughout history, gold has served as a measure of value and a symbol of wealth. It is one of the coinage metals (along with silver and copper). It is used, customarily and legally, as a means of payment or a medium of exchange. Gram and troy weight are the units of measurement used for gold. To indicate the amount of gold present in, say, a piece of jewelry, the term "carat" is used. A necklace, for instance, that is 24 carats means that it is made of pure gold.

While gold's price is determined through trading in the derivatives and gold markets, its daily benchmark price is provided in a procedure called the London Gold Fix. In this procedure, the price of the precious metal is determined each business day on the London market. The fixing is done twice - once in the morning and another in the afternoon. The latter actually was introduced about 49 years after the procedure itself was introduced, as a means of providing a price when US markets are open.

This gold-price fixing procedure is done by the five members of the London Gold Market Fixing Ltd., namely The Bank of Nova Scotia, Barclays Capital, Deutsche Bank AG London, HSBC, and Societe Generale Corporate & Investment Banking.

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## **Gold And Silver: The Two Precious Traditional Coinage Metals**

Four transition metals make up group 11 of the periodic table of elements. All, except one, are considered traditional coinage metals. Qualifying this further, only two of these three traditional coinage metals are considered precious metals. These are gold and silver.

Gold and silver are rare and have high economic values. These things can't be said of copper, the other traditional coinage metal. Occurring in nature in metallic form, these two precious metals can be produced sans the use of extraction metallurgy. These other characteristics of gold and silver make them both well suited for coinage:

- They are not radioactive.
- They are more ductile or softer than most other elements.
- They are less reactive compared with other elements.
- They have excellent luster.
- They have higher melting points compared with other metals.

The high-ductility property of gold and silver means they can be easily damaged as coins for circulation. Coins intended for circulation must be highly resistant to corrosion and wear. For this reason, gold or silver must be alloyed with other metals (example, manganese) so that the resulting coins will come out harder, more wear-resistant, and not easily damaged or deformed.

As numismatic items, gold and silver coins are made almost entirely of the precious metals, respectively. Current collectible gold coins (the 22-carat gold coins), for example, are made of 92% gold, with silver and copper comprising the rest. The coins in circulation in the United States prior to 1933 were made of 90% gold and 10% copper-silver combined. Canada's official gold bullion coin - The Canadian Gold Maple Leaf - is made of 99.999% gold; and so are these four other gold bullion coins:

1. British Britannia (with a face value of 100 pounds).
2. Chinese Gold Panda (with face values of 500, 200, 100, 50, and 25 Yuan).
3. Swiss Helvetia Head (with face values of 100, 20, and 10 Swiss francs).
4. Austrian Vienna Philharmonic (with face values of 100, 50, 25, and 10 euros).

Silver coins, like the minted coins circulated in the United States and other countries prior to 1965, were made of 90% silver and 10% copper. The American Silver Eagle and the Mexican Silver Libertad bullion coins, introduced in 1986 and 1982 respectively, were made of 99.9% silver and 0.1% copper.

Other notable silver bullion coins include the Australian Silver Kookaburra, Chinese Silver Panda, and the Russian George the Victorious.

Minting coins, whether gold or silver, always entails the risk of having the value of the metal used in the coin greater than the coin's face value. This is especially true in coins of low denomination. Because of this, there exists the possibility of some smelters taking gold or silver coins and melting these down for the scrap value of the precious metals.

A couple examples, in this regard, are worth mentioning here: US pennies have been made of copper-clad zinc since 1982, when they were before this time made of copper alloys; and British pennies were once made of 97% copper, but are now made of copper-plated steel.

As additional information, gold and silver both have a currency code of ISO 4217.

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## [Gold As An Investment: Ways Of Investing In Gold](#)

Four of the nine known precious metals are regarded as investment commodities. Of these four, gold is the most popular. Investing in gold is a way of protecting against crises that may be brought about by economic or political instability or by social unrest.

There are at least six ways of investing in gold:

### **Buying gold coins:**

This is the most popular way of investing in gold. Gold bullion coins are typically priced based on their weight; a premium is added to the gold spot price. Gold coins may be bought or sold over the counter in most Swiss banks.

### **Buying gold bars:**

This is the most traditional way of investing in gold. As in gold bullion coins, bullion gold bars can be bought or sold over the counter in most Swiss banks, as well as in major banks in Liechtenstein and Austria. There also are bullion dealers that provide this same kind of service. Gold bars however are becoming less and less an option among investors due to the difficulties (in the verification process, transportation, and storage) associated with them.



Gold IRA Investing

### **Opening a gold IRA account: [Our Recommended Top Gold IRA Company](#)**

Gold accounts are offered by most banks in Switzerland. Here, gold can be bought or sold in much the same

way foreign currencies are dealt. A gold account is backed either through non-fungible (allocated) gold storage or pooled (unallocated) storage.

### **Owning a gold certificate:**

A gold investor may opt to hold on to a gold certificate rather than store the physical gold bullion. The gold certificate allows the investor to buy and sell the security and do away with the many difficulties associated with the actual gold's transfer.

### **Trading in Gold Exchange-Traded Funds (GETFs):**

Trading in GETFs is like trading shares in, say, the New York Stock Exchange or the London Stock Exchange. Gold Bullion Securities, the first GETF introduced (in 2003, on the Australian Stock Exchange), stood for 1/10 of an ounce of gold. GETFs are a good means of gaining exposure to the price of gold, minus the inconvenience of storage. Trading in GETFs involves payment of commission and storage fee (charged on an annual basis). The expenses incurred in relation to the handling of the fund are charged through the selling of a certain amount of the gold as represented by the certificate. Over time, the amount of gold in the certificate, as may be expected, decreases.

### **Entering in a Contract For Difference (CFD):**

Some of the noted financial services firms, especially those in the United Kingdom, provide Contract for Difference (CFD). In this gold investment vehicle, two parties (a "buyer" and a "seller") enter into a contract, in which the seller agrees to pay the buyer the difference between the current value of gold and its value at contract time. In case the difference is negative, the seller receives payment instead from the buyer. A CFD, therefore, allows an investor to take advantage of long or short positions, enabling him/her to speculate on these markets.

In a related scenario, an investor may buy gold early in a condition where there is increased investor confidence. The investor then sells the gold before a general decline in the stock market sets in. Obviously in this case, the investor's aim is to gain financially.

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## **Gold Standard: Definition And The Three Distinct Kinds**

The gold standard is defined in many different reference materials as a monetary system in which the unit of currency used is a fixed quantity or weight of gold. Under this system, all forms of money, including notes and bank deposits, were freely converted into gold at the fixed price.

There are three known kinds of gold standard that have been adopted since the early 1700s - the gold specie, gold exchange, and gold bullion standards. Following is the definition and a brief historical account of each.

### **Gold Specie Standard:**

In this gold standard, the unit of currency is linked to the gold coins that are in circulation. More specifically, the monetary unit is associated with the unit of value of a specific gold coin in circulation along with that of any secondary coinage (coins made of metal that is valued less than gold).

Recorded history points to the existence of a gold specie standard in medieval empires. For example, the Eastern Roman Empire made use of a gold coin called Byzant (from the original Greek term Bezant).

The first known major area in the world to be on a gold specie standard in modern times is the British West Indies. That standard, however, was more of a commonly applied system rather than an officially established one. It was based on the Spanish gold coin called the doubloon.

The United States adopted the gold specie standard "de jure" (by law) in 1873, using the American Gold Eagle as unit.

#### **Gold Exchange Standard:**

In this gold standard, only the circulation of coins minted from lesser valuable metals (such as silver) may be involved. The authorities, however, will have undertaken a fixed exchange rate with a country that's on the gold standard.

Before the turn of the 20th century, countries that were still on silver standard started pegging their monetary units to the gold standard of either the United States or the United Kingdom. For example, Mexico, the Philippines, and Japan pegged their respective silver units to the U.S. dollar at fifty cents.

#### **Gold Bullion Standard:**

In this gold standard, gold bullion is sold on demand at a fixed price. It was introduced in 1925 by the British Parliament in an act which at the same time voided the gold specie standard.

Six years later, the United Kingdom decided to temporarily stop the gold bullion standard because of the large amount of gold that flowed out across the Atlantic Ocean. The gold standard eventually ended that same year.

One of the advantages of the gold standard is that it sort of restricts the government's power in inflating prices, which is possible through excessive issuance of paper currency.

Also by providing a fixed pattern of exchange rates, the gold standard may effectively lessen uncertainty in international trade.

As to its disadvantage, the gold standard may make monetary policy ineffective in stabilizing the economy in the event of a general slowdown in economic activity.

This is likely, as many economists fear, since under the gold standard the supply of gold would be the exclusive determinant to the amount of money.

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## Iridium: Most Corrosive Resistant Precious Metal

Iridium is a transition metal belonging to the platinum group. Its main characteristics are that of being hard and brittle and of being silvery-white in appearance. It ranks next to osmium in being the densest element. As to its main property, this is best expressed in its being considered the most corrosive resistant of all the precious metals. In fact, this is shown even in temperatures of as high as 2000°C (3632°F or 2273.15°K).

Iridium was discovered in 1803 by the English chemist Smithson Tennant. It was identified from the residue of platinum ore which was dissolved in nitro-hydrochloric acid (also known as aqua regia). Platinum ores are still the main sources today of iridium. The precious metal is likewise obtained as a by-product of mining nickel.

Below are some of the properties of iridium.

General:

- Chemical Symbol: Ir
- Atomic Number: 77
- Category (as an element): Transition Metal
- Group/ Period/ Block (in the Periodic Table): 9/ 6/ d
- Atomic Weight: 192.217 g.mol<sup>-1</sup>
- Electron Configuration: [Xe] 4f<sup>14</sup> 5d<sup>7</sup> 6s<sup>2</sup>

Physical:

- Density (near room temperature): 22.56 g.cm<sup>-3</sup>
- Liquid Density (at melting point): 19 g.cm<sup>-3</sup>
- Melting Point: 2466°C, 4471°F, 2739°K
- Boiling Point: 4428°C, 8002°F, 4701°K
- Heat of Fusion: 41.12 kJ.mol<sup>-1</sup>
- Heat of Vaporization: 563 kJ.mol<sup>-1</sup>

Atomic:

- Oxidation States: -3, -1, 0, 1, 2, 3, 4, 5, 6
- Electronegativity: 2.20 (Pauling scale)
- Atomic Radius: 136 picometre
- Covalent Radius: 141±6 picometre

Because of its characteristic of being very brittle, pure iridium is quite difficult - almost impossible, in fact - to machine. Its primary use is as a hardening agent for platinum. High-temperature equipment, such as crucibles, are made from platinum-iridium alloys. Compass bearings, balances and fountain pen tips, on the other hand, are made from osmium-iridium alloys.

Again, iridium is the most corrosive resistant precious metal known. Coupled with its resistance to extremely high temperatures, this special characteristic makes iridium ideal for use in certain parts of aircraft engines. It is also alloyed with titanium to make deep-water pipes.

Other uses of iridium include the following:

1. Electrical contacts for spark plugs (due to its resistance to arc erosion);
2. Computer memory devices;
3. Direct-ignition engine (as a catalyst);
4. Radiotherapy (as a source of radiation);
5. X-ray telescopes.

In 2007, worldwide demand for iridium reached 3,701 kilograms (119,000 troy ounces). Distribution of these were as follows: electrochemical uses (1,100 kilograms); electrical uses (780 kilograms); for catalysis (750 kilograms); and other applications (1,100 kilograms).

Iridium is found at highest concentrations within the Earth's crust in three specific types of geologic structures: in impact craters, in igneous deposits, and in deposits reworked from either of the first two. The Bushveld igneous complex in South Africa is the largest known primary reserves for iridium in the world. Other important sources of this precious metal are the Sudbury Basin in Canada and the nickel-copper-palladium deposits near Norilsk in Russia. Several smaller iridium reserves are also found in the United States.

Beginning the year 2000, the annual production of iridium is about 3 tonnes (96,500 troy ounces). Its price as of 2007 is 14,667 U.S. dollars per kilogram (440 U.S. dollars per troy ounce).

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## **Krugerrand: Most Well-Known Precious Metal Coin**

There are thirty-three known bullion coins in the world. Of these, 5 are made of platinum, 1 of palladium, 9 of silver, and 18 of gold. And of all these precious metal coins, the South African gold bullion coin Krugerrand is perhaps the most popular.

In 1967, the South African Mint Company introduced the Krugerrand, with the intention of circulating it as currency. Its status as a legal tender was seen as the best way for marketing South African gold around the world. In fact, thirteen years after its introduction, this precious metal coin accounted for about ninety percent of the gold coin market.

The Krugerrand comes in four varieties:

1. One-tenth ounce coin (0.11 troy ounce in weight, 1.35 millimeters thick, and 16.55 millimeters in diameter).
2. Quarter ounce coin (0.27 troy ounce in weight, 1.89 millimeters thick, and 22.06 millimeters in diameter).
3. Half ounce coin (0.55 troy ounce in weight, 2.22 millimeters thick, and 27.07 millimeters in diameter).
4. One ounce coin (1.09 troy ounces in weight, 2.84 millimeters thick, and 32.77 millimeters in diameter).

Each of these four coin varieties is 22K, containing 91.67% pure gold and 8.33% copper. This composition was meant to make the coins more durable and harder and thus resist dents and scratches, as, again, they were originally intended for circulation.

On the obverse of the Krugerrand is the face of Stephanus Johannes Paulus Kruger, fifth president of the South African Republic (note the surname Kruger and the South African currency Rand were combined to give this precious metal coin its name). Also here are the Afrikaans and English versions of the name "South Africa", both inscribed in capital letters.

On the reverse of the coin is an image of the springbok, an antelope specie which is a South African national symbol. Atop the image is an inscription of the name of the coin, in capital letters, while below it is the coin's gold content, inscribed in Afrikaans and English.

Special samples of the coin (proof Krugerrand) are minted and offered as collector's items. These proof Krugerrands are priced above the bullion Krugerrands. The two coin versions can be distinguished from one another by the number of serrations they have - the proof version has 220, while the bullion has 40 less than the former's.

Other nations, such as Canada, Australia, the United States, and the United Kingdom, started producing their own precious metal coins one after the other beginning in 1979. The decisions of these gold-producing countries to mint their own bullion coins were most likely inspired by the success of the Krugerrand in its role as a vehicle for promoting the South African gold to the international market. As of 2008, about 1.3 million kilograms of South African gold, contained in Krugerrand coins, have been sold.

Unlike the bullion coin series of other countries, which come in gold and silver, the Krugerrand comes only in gold. Coins made of silver that are passed off as "Krugerrands" are neither produced by the South African Mint Company nor sanctioned by the government of South Africa.

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## [Largest Gold Nuggets Discovered: Welcome Stranger And Hand Of Faith](#)

Gold nuggets are naturally occurring large masses of native gold found in alluvial deposits. Often they are concentrated by watercourses and recovered by placer mining. In other instances, gold nuggets are found in piles of residue in sites where mining operations once took place.

Two gold nuggets are noted for being the largest masses of gold ever discovered. These are the "Welcome Stranger" and the "Hand of Faith". Their respective "largest" titles, however, carry further qualifications.

### **The Welcome Stranger Gold Nugget:**

The exact distinction given of this gold nugget is: "the largest alluvial gold nugget ever found". It was discovered on February 5, 1869 at Moliagul, a small township in Victoria, Australia about 37 miles west of the city of Bendigo. The discoverers, John Deason and Richard Oates, found the nugget just a couple inches below the surface on a slope in a place that's sometimes called Black Reef.

Records have the following details about the Welcome Stranger:

- Gross weight: 3,523.5 troy ounces (241.61 pounds)
- Trimmed weight: 2,520 troy ounces (172.8 pounds)
- Net weight: 2,315.5 troy ounces (158.78 pounds)
- Measurement: 2 feet (0.61 meter) x 1.02 feet (0.31 meter)

For their find, Deason and Oates were paid about £19,068 by the London Chartered Bank (located in the town of Dunolly in Victoria), where they took the nugget.

The Welcome Stranger no longer exists today, although the gold from it understandably still does. Also, there exist two replicas of the nugget. One is in possession of the descendants of John Deason, while the other is in the City Museum in Treasury Place, in Melbourne.

### **The Hand of Faith Gold Nugget:**

This gold nugget actually carries two distinctions: "the largest gold nugget found by a metal detector" and "the largest gold nugget currently in existence". It was discovered on September 26, 1980 somewhere near the small town of Kingower in Victoria, Australia.

The nugget's discoverer, Kevin Hillier, was aided by a metal detector in this precious find. Hillier found the nugget in a vertical position just a foot below the surface.

The Hand of Faith weighs 874.82 troy ounces (60 pounds) and measures 1.54 feet (0.47 meter) x 0.66 feet (0.20 meter) x 0.30 feet (0.09 meter). The Golden Nugget Casino in Las Vegas, Nevada currently houses the nugget. Its sale price was reportedly around 1 million U.S. dollars.

Gold nuggets actually are not composed of pure 24K gold. A safer estimate would be that they're somewhere between 20K and 23K. Those found in Australia often have higher purity than the ones found in Alaska. The color of a nugget often provides a clue as to the purity of its gold content. Nuggets that have very rich deep orange/yellow color are sure to have higher gold content than pale ones.

Also, there is a system called "millesimal fineness" which is used to denote the purity of gold alloy (also of silver and platinum alloys) by parts per thousand of pure metal by mass in the alloy. A nugget containing 91.6% gold, for example, is denoted as "916 fine". This fineness is equivalent to 22K.

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## **Osmium: Densest Precious Metal**

Osmium is an extremely hard, brittle, bluish white or gray transition metal in the platinum group metals. It is the densest natural element, being about 0.03 g/cm<sup>3</sup> denser than iridium (the second densest natural element) and about twice as dense as lead. Among the platinum family members, osmium has the highest melting point and the lowest vapor pressure.

This precious metal is nearly impossible to fabricate. When alloyed with some of the other metals in the platinum group, such as iridium or platinum, osmium is used in certain applications where extreme hardness and durability are required. A couple examples of these are for electrical contacts and for tips of high quality fountain pens.

Some of the properties osmium possesses are outlined below.

### **General:**

- Chemical Symbol: Os
- Atomic Number: 76
- Category (as an element): Transition Metal
- Group/ Period/ Block (in the Periodic Table): 8/ 6/ d
- Atomic Weight: 190.23 g.mol<sup>-1</sup>
- Electron Configuration: [Xe] 4f<sup>14</sup> 5d<sup>6</sup> 6s<sup>2</sup>

### **Physical:**

- Density (near room temperature): 22.59 g.cm<sup>-3</sup>
- Liquid Density (at melting point): 20 g.cm<sup>-3</sup>
- Melting Point: 3033°C, 5491°F, 3306°K
- Boiling Point: 5012°C, 9054°F, 5285°K
- Heat of Fusion: 57.85 kJ.mol<sup>-1</sup>
- Heat of Vaporization: 738 kJ.mol<sup>-1</sup>

#### **Atomic:**

- Oxidation States: 8, 7, 6, 5, 4, 3, 2, 1, 0, -1, -2
- Electronegativity: 2.2 (Pauling scale)
- Atomic Radius: 135 picometre
- Covalent Radius: 144±4 picometre
- Ionization Energies: 840 kJ.mol<sup>-1</sup> (first), 1600 kJ.mol<sup>-1</sup> (second)

The name "osmium" was derived from the Greek word "osme", which means "smell". It was discovered by the English chemists William Hyde Wollaston and Smithson Tennant in London, England in 1803. Wollaston's and Tennant's discovery of the element involved the discovery as well of the other elements in the platinum group.

With an average mass fraction of 0.05 parts-per notation in the continental crust, osmium is known to be one of the least abundant elements in the Earth's crust. It is found in nature in natural alloys or as a pure element. Similar to the other precious metals in the platinum group, osmium can be found in alloys with copper or nickel.

The extreme toxicity and volatility of osmium's oxide makes it nearly impossible for this element to be used in its pure state.

For this reason, it is often necessary to alloy osmium with other elements for use in high-wear applications. For example, osmiridium (a natural alloy of osmium and iridium) is alloyed with the other metals in the platinum group and used in instrument pivots and phonograph needles (apart from electrical contacts and fountain pen tips as mentioned earlier).

In another example, osmium tetroxide is used to detect fingerprints and to stain fatty tissue for optical and electron microscopy.

Osmium occurs in the platinum-bearing river sands in North America, South America, and in the Ural Mountains in Russia.

The latter, in fact, is known to be the site of the second largest alluvial deposit, which today is still mined. The approximate price of commercial osmium (99 percent pure osmium powder) is 100 U.S. dollars per gram.

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## Palladium: Least Dense Of The Platinum Group Metals



Palladium is a rare precious metal characterized by its lustrous silvery-white appearance. It was discovered by the English chemist William Hyde Wollaston in London, England in 1803, along with his discovery (together with Smithson Tennant, another English chemist) of the other metals in the platinum group. The name "palladium" was coined by Wollaston from the asteroid named "Pallas".

Of the different precious metals in the platinum group (which includes iridium, platinum, osmium, rhodium, and ruthenium), palladium is known to be the least dense. It likewise has the lowest melting point.

Palladium is utilized in many applications because of its unique properties, some of which are provided below.

### **General:**

- Chemical Symbol: Pd
- Atomic Number: 46
- Category (as an element): Transition Metal
- Group/ Period/ Block (in the Periodic Table): 10/ 5/ d
- Atomic Weight: 106.42 g.mol<sup>-1</sup>
- Electron Configuration: [Kr] 4d<sup>10</sup>

### **Physical:**

- Density (near room temperature): 12.023 g.cm<sup>-3</sup>
- Liquid Density (at melting point): 10.38 g.cm<sup>-3</sup>
- Melting Point: 1554.9°C, 2830.82°F, 1828.05°K
- Boiling Point: 2963°C, 5365°F, 3236°K
- Heat of Fusion: 16.74 kJ.mol<sup>-1</sup>
- Heat of Vaporization: 362 kJ.mol<sup>-1</sup>

### **Atomic:**

- Oxidation States: 0, +1, +2, +4, +6
- Electronegativity: 2.2 (Pauling scale)
- Atomic Radius: 137 picometre
- Covalent Radius: 139±6 picometre
- Van der Waals Radius: 163 picometre
- Ionization Energies: 804.4 kJ.mol<sup>-1</sup> (first), 1870 kJ.mol<sup>-1</sup> (second), 3177 kJ.mol<sup>-1</sup> (third)

### **Palladium is used in the following:**

1. Catalytic converters;
2. Jewelry and watch making;
3. Dentistry and surgical instruments;
4. Aircraft spark plugs;
5. Electrical contacts;
6. Connector platings;
7. Manuscript illumination.

Since the late 1930s, palladium has been utilized as a precious metal in jewelry. Because of its naturally white properties, palladium has been used as an alternative to white gold. Along with silver and nickel, palladium is popularly used in making white gold alloys.

According to the British Geological Survey (BGS), the top four palladium-producing countries in the world are Russia, South Africa, Canada, and the United States (in this order). Russia produces at least half of the total amount of palladium produced in the world.

Commercially, palladium is produced from copper-nickel deposits in Siberia, South Africa, and in Ontario in Canada. The precious metal is also found - alloyed with the other metals in the platinum group as well as with gold - in Ethiopia, Australia, North and South America, and in the Ural Mountains in Russia.

The Norilsk Nickel Mining and Metallurgical Company in northern Russia is the largest single producer of palladium in the world. Significant amounts of mineable palladium are also found in two other places: the Lac des Îles igneous complex in northwestern Ontario, Canada and the Stillwater igneous complex in the state of Montana in the United States.

Such is the rarity and preciousness of palladium that many metric tons of ore have to be processed to obtain just a troy ounce of the precious metal. The ISO currency codes of palladium, as a commodity, are XPD and 964. Its price is approximately 150 U.S. dollars per troy ounce.

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## **Palladium And Platinum As Investment Commodities**

Palladium and platinum are two of nine metallic chemical elements considered "precious" for their rarity and high economic value. Like all the other precious metals, palladium and platinum have various industrial uses. But apart from these, both are also regarded as investment commodities.

### **Palladium as an investment commodity:**

Palladium is valued at around US\$415 per troy ounce. Actually, this is much lower than its price of more than one thousand U.S. dollars per troy ounce in early 2001, when the automobile industry placed a high demand for the precious metal for use as catalytic converters.

As an investment commodity, palladium may be bought in forms of bullion coins or bars. Palladium bullion coins are internationally recognized forms of currency and have the ISO codes XPD and 964.

The first known palladium coins to be issued were those of Sierra Leone in 1966. The following year, Tonga started issuing theirs.

Other countries later began issuing their own palladium bullion coins, including Canada (with its Big & Little

Bear Constellations and the very popular Palladium Maple Leaf), Australia, France, China, Portugal, and the former Soviet Union. The latter, in fact, is known to have minted the most number of palladium coins in the world.

Because of low circulation of palladium coins, palladium as an investment commodity is not as good as either silver or gold. Another reason for this is the relatively wider spread between the metal's buying and selling prices.

Palladium is traded on the London Stock Exchange as an exchange-traded fund (ETF), under the ticker symbol LSE: PHPD.

#### **Platinum as an investment commodity:**

As of January 2010, platinum is valued at around us\$1,555 per troy ounce (a couple years earlier, its price is about 48% higher than this - considered its peak price).

Compared with silver or gold, platinum tends to trade at a higher per-unit price because it is scarcer and has lower mine output. The average mine production of platinum is 5 million troy ounces per year.

This is lower by about 77 million troy ounces when compared with the annual mine production of gold, and even much lower - by about 547 million troy ounces - when compared with the yearly silver mine production.

Platinum is traded on the London Stock Exchange (as ETF, under the ticker symbol LSE: PHPT) and on the New York Mercantile Exchange. One way of investing in platinum is through platinum ingots. Platinum ingots are first assayed and hallmarked before being sold on commodity markets.

Another way of investing in platinum is through platinum coins. Platinum coins are internationally recognized forms of currency and have the ISO code XPT. However, there are only a few varieties of platinum coins minted, largely because of the cost of platinum and of the difficulty in working with it.

Bullion coins minted from platinum include the Manx Noble (minted from 1983 to 1989), the Canadian Platinum Maple Leaf (1988 to 1999), the Australian Platinum Koala (1988 to the present), the Mexican Libertad (1989 only), and the American Platinum Eagle (1997 to the present).

The Chinese Platinum Panda were minted in three periods: from 1988 to 1990, 1993 to 1997, and lastly from 2002 to 2005.

Platinum accounts are offered by most banks in Switzerland. Here, platinum is treated like any other foreign currency; that is, it can be bought or sold instantly. However, bank clients are not entitled to ownership of the physical metal. Instead, they have a claim against their banks for a specified quantity of the metal.

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## Placer Mining: Three Methods Used To Mine Placer Gold

The word placer, as will be found throughout here, is derived from the same Spanish word which means "sandbank". It specifically refers to an alluvial deposit of detrital material, such as gravel, which contains particles of precious chemical elements.

The term "placer gold", therefore, refers to gold that has formed in rocks moved and placed on stream beds by some geological forces and by the action of water. Lode gold tends to erode from its source, distributing itself naturally among other rocks that have been subjected to similar geological forces. This results to the formation of a secondary deposit.

Thus the mining of alluvial deposits for gold and other precious metal deposits is called "placer mining". Placer mining may be done through a number of tunneling procedures into riverbeds. There also are the open-cast mining and hydraulic mining. In the former, placer mining is done by open-pit; in the latter, water pressure is used for excavation.

There are three placer mining methods used to mine placer gold:

### **Gold Panning:**

This method, which involves the use of a pan, is the oldest and simplest way to extract gold from a placer deposit. In this method, mined ore is placed in a large pan (made either of plastic or metal) and poured with a liberal amount of water; it is then agitated. The gold particles, having higher density than the other materials (examples, mud, sand and gravel; also, gold is about nineteen times heavier than water), settle to the bottom of the pan, while the lighter materials are washed over the side.

### **Sluice Box:**

This method uses the same principle as that in gold panning, only on a larger scale. In this method, a short sluice box is used. The box is constructed with barriers along its bottom, so that the gold particles are trapped as all materials are washed by water. The sluice box method is best suited for excavation in which certain implements, such as shovels, are used to feed ore into the box.

### **Trommel:**

This method involves the use of a screened cylinder to separate materials by size (trommel is Dutch word for "drum"). A trommel specifically consists of a rotating metal tube that is slightly tilted, with a screen at the discharge end. Attached to the inside part of the metal tube are lifter bars.

Ore is fed into the trommel through its elevated end. Pressurized water is supplied to the tube and the screen sections. Valuable minerals from the ore are separated by the combination of water and mechanical action. The small pieces of ore bearing the valuable minerals pass through the screen and are concentrated further in sluices. The larger ones (those that do not pass through the screen) are moved to a waste stack using a conveyor.

Today, placer mining goes on in many parts of the world as a source of gems and industrial metals and minerals. This is true in countries like Sri Lanka and Myanmar. Placer mining for placer gold continues in British Columbia, the Yukon, and especially in Alaska.

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