

Palladium (Pd) - Student Datasheet

Element 46 · Transition metal · platinum-group metal · source-reviewed learning reference

Palladium is element 46, a platinum-group metal whose surface chemistry makes it a powerful catalyst. Its FCC lattice can also absorb substantial hydrogen, linking atomic-scale interstitial behavior to membranes, catalysis and materials research.

Quick reference

Atomic number	46
Relative atomic mass	106.42
Electron configuration	[Kr] 4d ¹⁰
Period / group / block	5 / 10 / d
State context	Silvery-white noble metal · solid at 20 °C
Density	12.0 g/cm ³
Melting / transition	1828 K
Boiling / gas reference	3236 K
Oxidation states	0, +2, +4
Electronegativity	2.20

Structure & orbitals

Palladium is FCC near room temperature. The viewer is a conventional-cell teaching model; absorbed/interstitial hydrogen changes the material system and is treated separately.

The 4d probability clouds are representative isolated-atom angular forms. They are not a direct map of a palladium catalytic surface or hydrogen-filled metal band structure.

Phase behavior

At approximately standard pressure, palladium is FCC solid below about 1828 K, liquid to about 3236 K, and gaseous above the boiling reference.

Five things to remember

- Atomic number 46 means 46 protons.
- The reference configuration is [Kr] 4d¹⁰.
- Palladium metal is FCC near room temperature.
- Palladium surfaces are widely used in catalysis.
- Hydrogen can dissolve in/interact with palladium metal; that is a material-system property, not a separate element.

Palladium: Real World & Signature Science

Element-specific science, uses and history

Big idea

Palladium's market price is not the chemistry lesson. The distinctive science is how a filled 4d shell, metallic surfaces and hydrogen interactions support catalytic and materials behavior.

Why this element is scientifically distinctive

Rotate a ^{106}Pd nucleus and FCC metal cell, inspect representative 4d clouds, then follow the Signature Science path from clean Pd lattice to interstitial hydrogen and catalytic surface chemistry.

Catalytic converters	Palladium catalysts help convert harmful exhaust gases in vehicle after-treatment systems.
Chemical catalysis	Palladium compounds and surfaces enable many industrial and laboratory coupling/hydrogenation reactions.
Hydrogen interaction	Hydrogen can diffuse into and dissolve in palladium, making Pd important in membrane and hydrogen-material research.
Electronics & dentistry	Palladium appears in selected electronic components, alloys and dental materials.
Recycling	Because palladium is scarce and valuable, recovery from catalytic converters and industrial materials is important.

From platinum-group ores to palladium products: high-level path

1. Palladium occurs with other platinum-group metals in complex ore systems.
2. Concentration and refining separate platinum-group elements through multi-stage industrial processes.
3. High-purity palladium is fabricated into catalysts, alloys, electronic materials or chemical compounds; operational refining recipes are outside this guide.
4. Recycling from used catalysts and industrial scrap is a major secondary source.

History checkpoints

1803	William Hyde Wollaston discovered palladium while studying platinum ores.
19th-20th centuries	Palladium found roles in jewellery, dentistry and chemical catalysis.
Late 20th century	Automotive catalytic converters became a major palladium use.
Today	Catalysis, electronics, hydrogen materials and recycling dominate the element's technological story.

Palladium: Isotopes, Questions & Evidence

Evidence status and learner self-check

Isotope context

¹⁰⁶ Pd	Stable natural isotope	Reference teaching nucleus with 46 protons and 60 neutrons.
¹⁰⁸ Pd	Stable natural isotope	One of several stable natural palladium isotopes.
¹⁰⁷ Pd	Long-lived radioactive isotope	Relevant to nuclear/geochemical research rather than ordinary bulk palladium use.

Common questions

What is palladium?

Palladium is element 46, a platinum-group transition metal.

What is palladium used for?

Major uses include catalytic converters, chemical catalysis, electronics and precious-metal alloys.

Where is palladium found?

It occurs in platinum-group and nickel/copper ore systems; major mine supply is concentrated in a few countries.

Is palladium a metal?

Yes. It is a noble platinum-group metal.

Quick self-check

Q: What is palladium's atomic number? | Answer: 46. Atomic number equals proton count.

Q: What is the ordinary crystal structure? | Answer: FCC. Palladium metal is FCC.

Q: What is a major palladium use? | Answer: Catalysis. Palladium surfaces and compounds are important catalysts.

Evidence & safety

Atomic and ordinary FCC bulk values are evaluated/measured. Hydrogen interaction is presented as a palladium-hydrogen material phenomenon. Mine-production geography is dated and selective.

Catalytic, powder, compound and bulk-metal forms can have different hazards. This page is not a handling guide.

Core sources

Royal Society of Chemistry - Palladium

<https://periodic-table.rsc.org/element/46/palladium>

NIST - Atomic Data for Palladium

<https://physics.nist.gov/PhysRefData/Handbook/Tables/palladiumtable1.htm>

USGS - Mineral Commodity Summaries 2026

<https://pubs.usgs.gov/publication/mcs2026>