The Current Application Status and Prospects for Platinum Group Metal-Based Materials

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Contents

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➢ Milestone

✓ **Stages:** ***Research linstitute*** → ***Research & Industry*** → ***High-tech PGMs materials company***

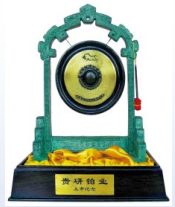
1928 — Institute of Engineering

2000 — Restructure to enterprise

2016 — Regroup to New SPM

1962 — Kunming Institute of **Precious Metals** (IPM)

2003 — In 2003, SPM went into IPO



2024 — Leading precious metal enterprise in China

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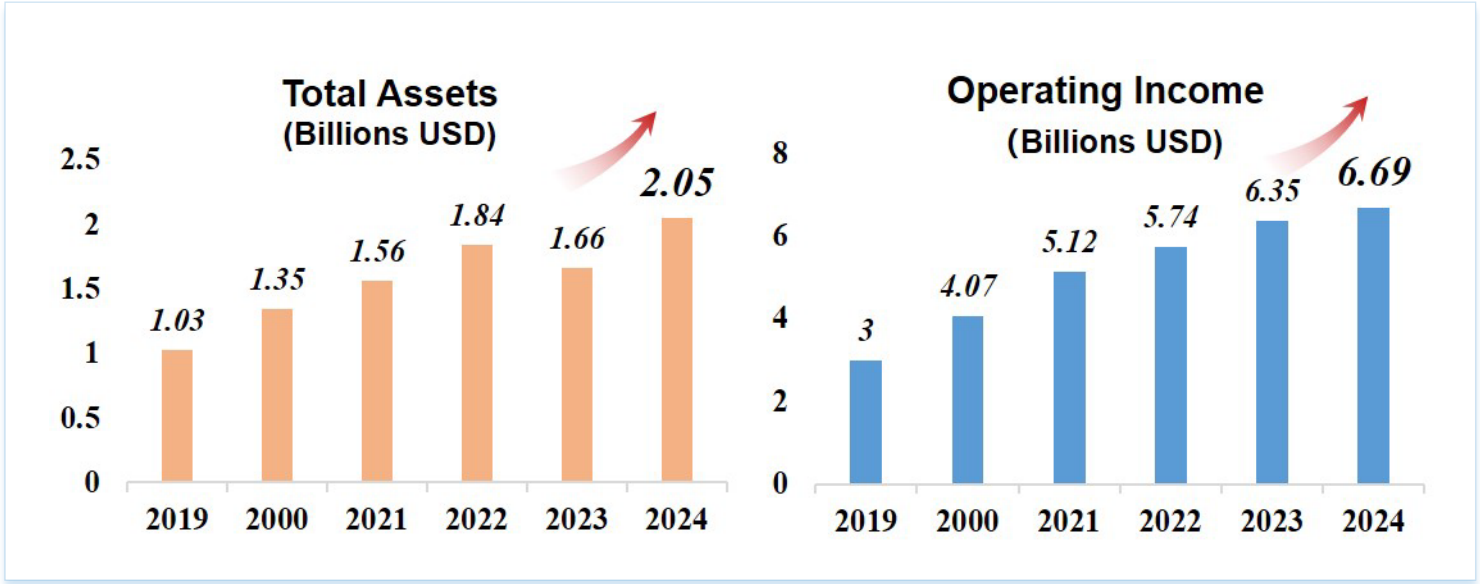
➢ We Provide Excellent Services:

- Precious metal Refining and Recycling
- Precious metal materials Production
- Materials Analysis
- Scientific Research Communication
- …

➢ What We Achieved:

- State key Laboratory
- High-tech company
- Precious Metals Alliance
- Various Industry Awards
- …



Rapidly progressed in recent year

- ✓ The **founder** and the **leader** of Chinese PGMs industry.
- ✓ The leader company for the precious metal materials via **Recycling** / **Production** & **Scientific Research** in China.

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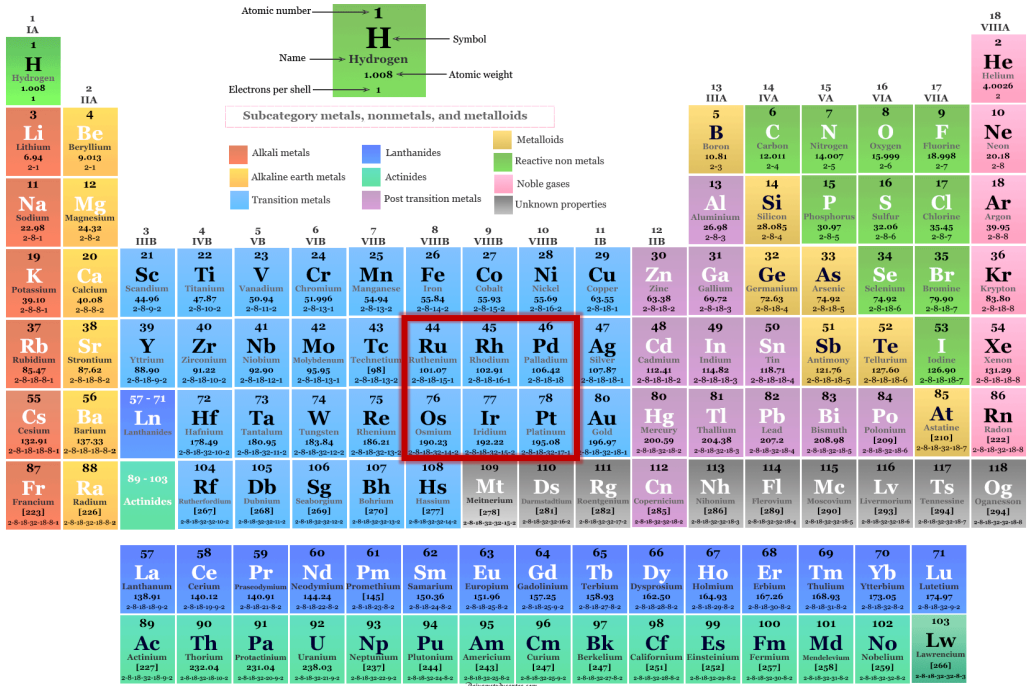
Applications of Platinum Group Metals (PGMs)



PGMs located in Periodic Table

Physical properties of the PGMs

PMGs (Elements)	Discovery Year	Melting point (℃)	Density (g/cm³)	Values ($/oz) (2025.10)
Platinum (Pt)	1748	1769	21.45	1664
Palladium (Pd)	1803	1552	12.02	1487
Rhodium (Rh)	1803	1960	12.41	7667
Iridium (Ir)	1803	2443	22.65	4714
Osmium (Os)	1803	3050	22.16	2200
Ruthenium (Ru)	1844	2310	12.45	960

✓ PGMs are with high-value, high melting point, excellent corrosion resistance and catalytic performance!

Applications of PGMs

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Applications


Electronic Information


Environmental

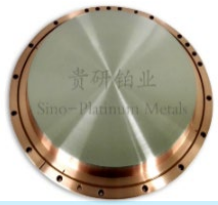

Energy


Health & Safety

Different Material forms

High-purity Metal

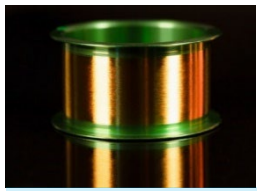

Evaporation


Sputter target

High purity powers

Alloy


Brazing alloy


Encapsulation metal

Contact material

Crucibles

Thermal Couples

Slurry

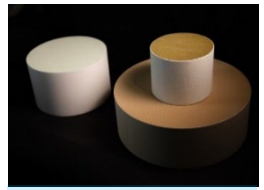

Conductive paste


Sensor slurry

Resist paste

Chemistry, catalyst and medical

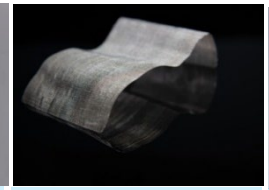

Basics chemicals


Automotive catalysts


Industrial catalysts


Electroplating salt

Research Reagents


Catalysis net

Homogeneous catalyst


Medical

Colloid

✓ PGMs-based materials are widely used in various fields, which is essential for human life!

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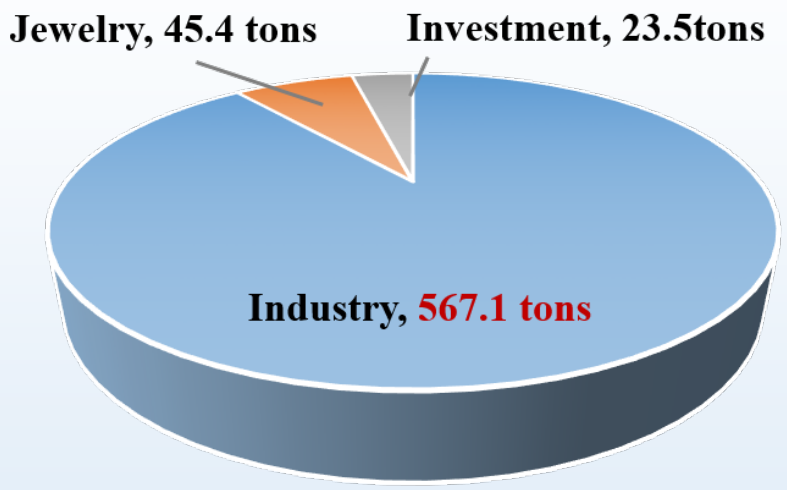
Global Demand of PGMs

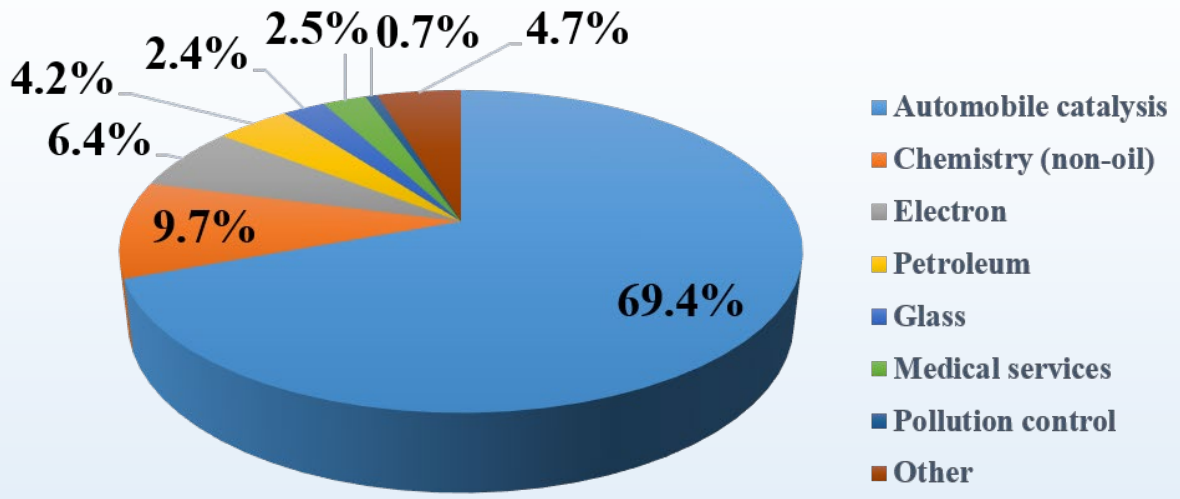
Global Major PGMs Demand (2024)



Total demand : ~636 tons

Industrial applications accounted for 89.2%

PGMs used in industrial Applications (2024)



Total demand : ~567tons

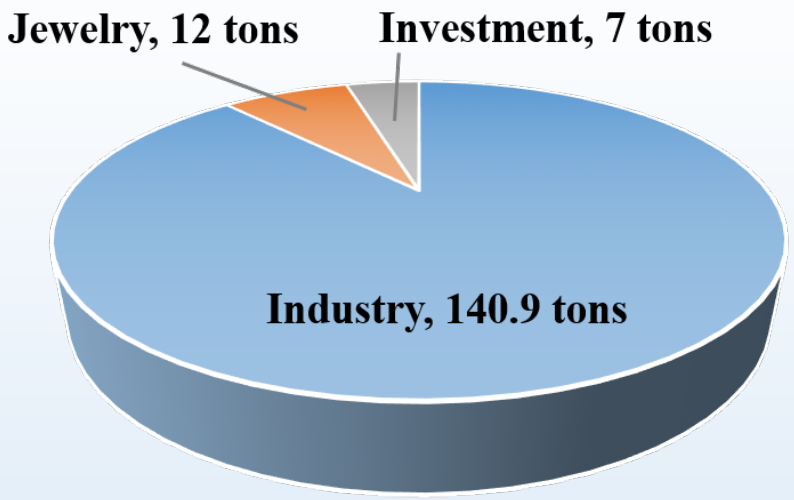
The automotive catalysis is the largest industrial application of PMGs

(Pt40%, Pd80%, Rh90%)

*Source: Johnson Matthey, Kunming Institute of Precious Metals

PGMs Demand in China

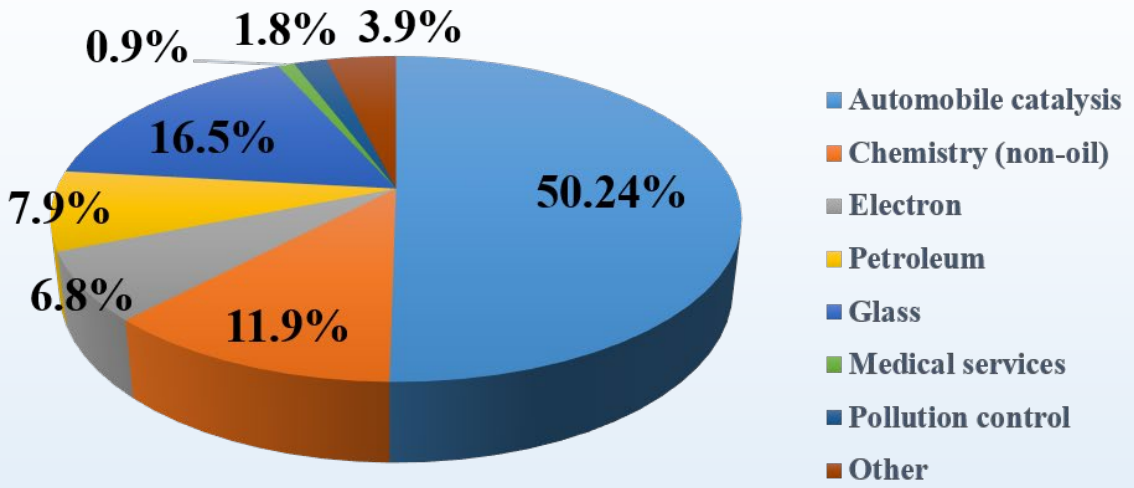
Major applications of PGMs in China (2024)



Total demand : ~160 tons

Industrial applications accounted for 88.1%

PGMs used in industrial Applications in China (2024)

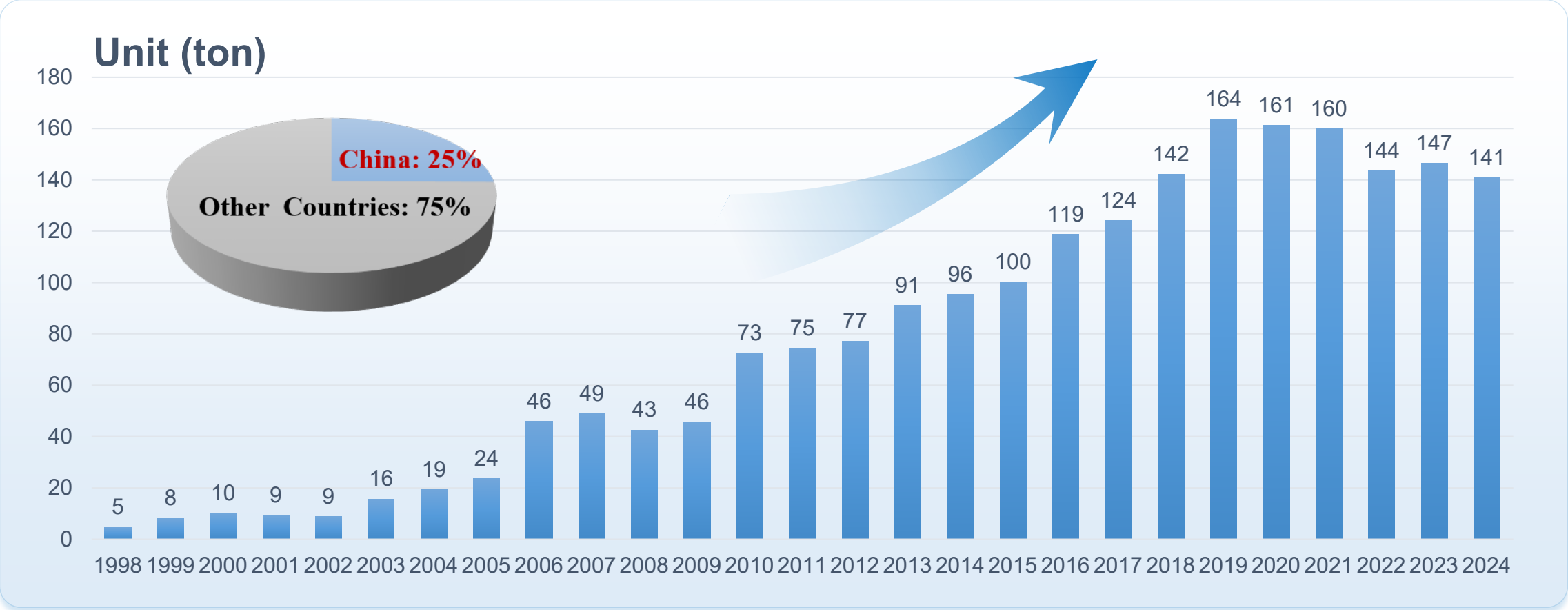


Total demand : ~141 tons

The Chinese market has the largest demand for PGMs in the automotive, glass, and chemical industries

*Source: Johnson Matthey, Kunming Institute of Precious Metals

Demand of PGMs in China



- ✓ The demand and usage of PGMs in China are rapidly increasing;
- ✓ It is expected to be the world's largest market for PGMs recycling and materials manufacturing in the world.

Contents

PMGs-based Materials leads to a Green Future

PGMs catalyst as Automobile exhaust catalyst

Petrol car

Diesel vehicle

Natural Gas vehicles

Platinum group metal catalysts

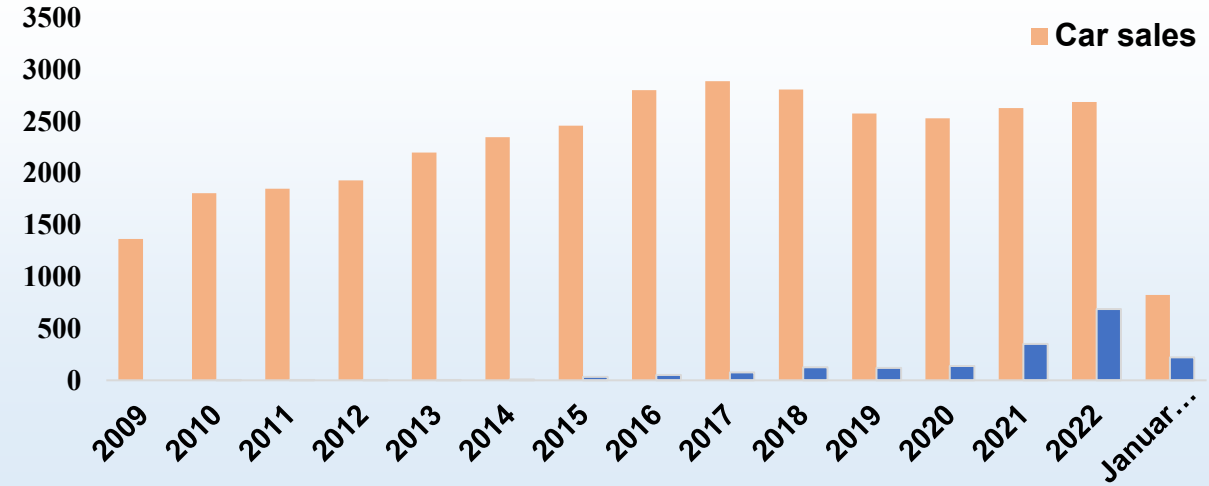
Achieve exhaust emissions standards

Challenges:

- Decreasing in gasoline vehicle market
- Electric-powered vehicle

Solutions:

- Reduce in usage of PGMs
- Development for diesel vehicle
- New demand for hybride vehicles



✓ PGMs demand: Stable diesel Vehicle demand and rapid demand for new energy vehicles in future

PMGs-based Materials leads to a Green Future

Environmental Catalyst

PGMs catalyst for volatile organic compounds (VOCs) control

PGMs catalyst is developed to be used in the low-temperature catalytic combustion for treating VOCs exhaust gas, with the advantages of low temperature, high efficiency, and environmental protection.

PGMs catalysts for industrial Organic Wastewater

PGMs is developed to be used as wet oxidation catalytic for treatment of industrial organic wastewater. It is effective in the treatment of various toxic, harmful and difficult-to-degrade high-concentration organic wastewater. Under conditions of high temperature and high pressure with catalysts, the organic pollutants are oxidized into inorganic or organic small molecules in the liquids.

✓ Developments of PGMs catalysis for waste treatment gains significant environmental benefits!

PMGs-based Materials leads to a Green Future

PGMs materials for High-quality glass production

High temperature PMGs alloy leakage plate

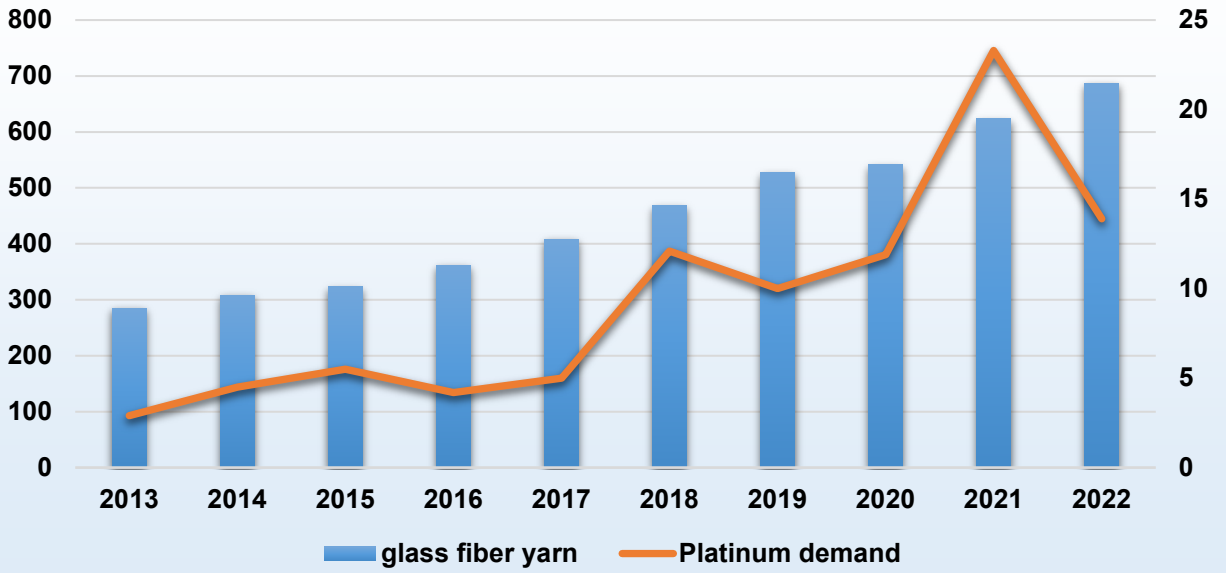
(Pt + Rh)

Glass fibre

Information & energy conservation etc.

Optical glasses

High purity
Long time heat treatment



- ✓ At present, the overall demand of PGMs for the glass fibre industry decrease.
- ✓ However, the demand of high temperature PMGs alloy for optical glasses gradually increase.

PMGs-based Materials leads to a Green Future

PGMs for catalysts for Hydrogen industry

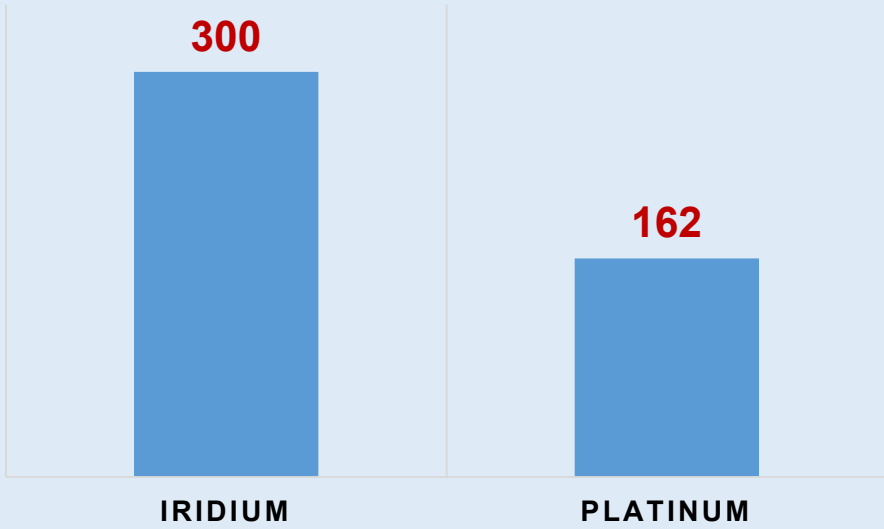
PGMs-based materials used in hydrogen production

element	Hydrogen technology sector		
Cerium	PEMFC		
Chromium	R+CCS		
Cobalt	R+CCS		
Copper	AEL	PEMFL	R+CCS
Black lead	AEL		
Iridium	PEM E L		
Manganese	R+CCS		
Molybdenum	R+CCS		
Nickel	AEL	R+CCS	
Platinum	PEM E L	PEMFC	
Titanium	PEM E L	R+CCS	
Tungsten	R+CCS		
Vanadium	R+CCS		

Source: "Sufficiency, Sustainability and Circularity of Critical Materials for Clean Hydrogen"

- Alkaline electrolytic cell (AEL)
- Polymer electrolyte membrane electrolyzer (PEMEL)
- Proton exchange membrane fuel cell (PEMFC) Hydrogen conversion technology using carbon capture and storage (R+CCS)

Estimated cumulative demand for Ir and Pt for hydrogen production in 2050 (tons)



Source: "Sufficiency, Sustainability and Circularity of Critical Materials for Clean Hydrogen"

- ✓ Two key materials: Platinum and Iridium
- ✓ The cumulative demand for PGMs in hydrogen industry is expected to 460 tons in 2050

PMGs-based Materials leads to a Green Future

Hydrogen Energy Industry

Production
Basic materials and hydrogen production

Bipolar plate material
- Graphite bipolar plate
- Metal bipolar plate
- Composite material bipolar plate

Membrane materials
- General purpose perfluorinated proton exchange membrane
- Enhanced perfluorinated membrane
- High temperature membrane

Catalyst
- platinum based catalyst
- Nuclear shell catalysts
- Nanocatalyst
- Non-patinum catalysts

electrolyte
- Carbonate matrix
- Solid oxide
- All-fluorosulfonic acid solid polymer

Hydrogen production
- Electrolysis of water for hydrogen production
- Hydrogen production from natural gas reforming
- Methanol-based hydrogen production

Production & Transportation

Transportation
Fuel cell system

Fuel cell stack

Membrane electrode MEA assembly
- Proton exchange membrane
- Gas diffusion layer

Other components
- Bipolar plate
- gasket ring

air circulation system
- air compressor
- expander
- Micro motors
- Connecting pipes

Hydrogen supply system
- Hydrogen safety monitoring and emission device
- Hydrogen recirculation unit
- Cryogenic gas storage tank
- Hydrogen supply lines

supplementary system
- Moisture control systems
- Water Thermal Management System
- Power control system ○
- Power station automation system

Refuelling & storage

Storage
Fuel cell applications

Fixed power stations
- Phosphoric acid fuel cell (PAFC)
- Molten carbonate fuel cell (MCFC)

Portable power supply
- Solid oxide fuel cell (SOFC)
- Direct methanol fuel cell (DMFC)

traffic
- Proton exchange membrane fuel cell (PEMFC)

Military field
- Alkaline Fuel Cell (AFC)

✓ PGMS-based materials are essential for the hydrogen production, transportation and storage.

A Brief Summary

- The demand and usage of PGMs in China are rapidly increasing, and China is expected to be the world's largest market for PGMs in the foreseeable future.
- The PGMs-based materials, which are essential for the various application, including electronic information, environmental, energy industry, as well as health and safety etc.
- Development of PGMs-based materials used as new generation of automotive catalyst, treatment of harmful gas, waste water treatment, and electrodes and membrane materials for hydrogen energy application, which demonstrates to a green future.
- The Sino-Platinum Metals Co., Ltd., as the leader of the PGMs recycling & refining, material production, and scientific research in China. Welcome all the global partners!

Thanks for your kind attention!

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