Mining the metals of the future

Hafnium is essential to aerospace superalloys & microchips

Aerospace applications

Hafnium's stability and strength at high temperatures in both metallic and compound form makes it ideal for several aerospace applications

Superalloys for jet engines

Hafnium is considered irreplaceable in the MAR M 247 superalloy, used in the hot part of jet engines (turbine blades and vanes).

NASA re-entry modules

Hafnium diboride (HfB_2) is used for ultra high-temperature ceramics or coatings for components in NASA atmospheric re-entry modules.

Industrial applications

Hafnium and its compounds are not limited to high-temperature aerospace applications, but are used in industry as well

Industrial gas turbines

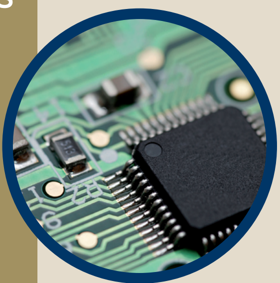
Hafnium-containing superalloys are used in the larger cast parts of turbines for electricity generation.

Plasma cutting tips

Hafnium is used in plasma cutting tips and welding torches due to its high melting point and ability to shift electrons into the air.

Optoelectronics

Having fantastic electrical insulation and high-index/low optical absorption properties, hafnium oxide has many applications in the optoelectronics industry.



Integrated circuits

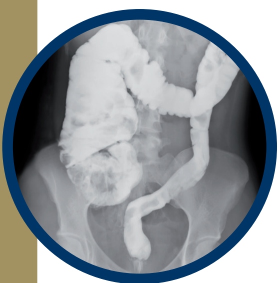
Using hafnium oxide to replace silicon dioxide gate insulators has allowed a significant leap forward in the quest to shrink computer chips and improve efficiency.

Optical Coatings

Thin deposits of hafnium oxide provide hard, scratch-free coatings for applications such as near-UV laser anti-reflective and dielectric mirror designs.

Unleashing hafnium's potential

Researchers across the globe are exploring a raft of potential applications for this relatively unexploited element.



New cancer treatments

Use of hafnium oxide nanoparticles in radiation oncology to destroy cancer cells is being explored.

Thermal reflector

Prototypes of thin lamellar composites of hafnium oxide, silicon dioxide and silver are being developed to reflect sunlight back into space to assist with air conditioning buildings.

Mining the metals of the future

Hafnium

What is it?

Hafnium is a lustrous grey metal that lends unique properties to certain high-temperature superalloys used in the aerospace industry, allowing them to maintain high strength and stability when operating at very high temperatures. Hafnium also has increasing use in oxide form as an electrical insulator in the microelectronics industry.

Chemically resembling zirconium, hafnium is always found in zirconium minerals, from which it needs to be extracted using advanced metallurgical processing. It is usually traded as hafnium metal in 'crystal bar' form, or as hafnium oxide (HfO_2) or hafnium tetrachloride ($HfCl_4$).

Image: http://images-of-elements.com/hafnium-2.jpg

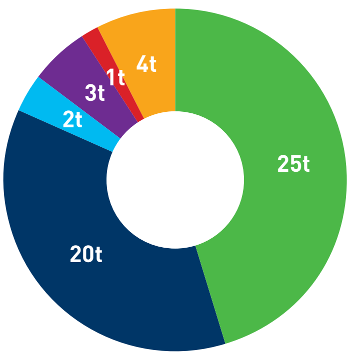
Dubbo Zirconia Project

At the Dubbo Zirconia Project (DZP), the source of hafnium is a hydrous zirconium silicate mineral (not zircon) containing hafnium oxide within the orebody. To produce high-purity zirconium materials, the DZP is developing the process to separate hafnium from zirconium. At a planned ore processing rate of one million tonnes per annum and a hafnium recovery rate of 50%, the DZP could produce up to 200tpa of hafnium in the form of hafnium oxide. This is more than triple the current world hafnium supply - without reliance to the nuclear industry.

World production

To date, most of the world's hafnium metal has been produced as a by-product of the nuclear industry, which requires hafnium-free zirconium. The two main producers are in France and the USA (accounting for ~75% of the market). However, demand for hafnium is starting to outstrip production. An estimated 50-60t of hafnium will be produced in 2015. Demand, meanwhile, is expected to be 70-80t and is on the rise, particularly for use in high-temperature superalloys.

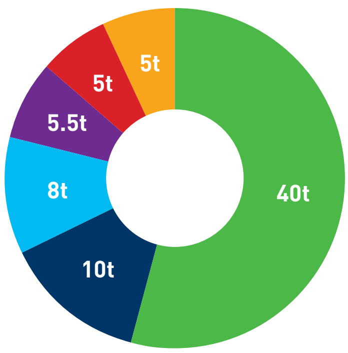
75% of hafnium metal is produced in France and the USA as a by-product of zirconium metal manufacture.



Hafnium Supply
2015 Estimated
50 - 60 tonnes

- AREVA
- ATI
- China
- Westinghouse
- Others
- Scrap

Demand for hafnium is outstripping production, with an increasing volume used in high-temperature superalloys.



Hafnium Demand
2015 Estimated
70 - 80 tonnes

- Superalloy
- Hf Oxide for Optical
- Nuclear
- Plasma Cutting Tips
- CVD / Targets
- Other