

The background of the image features a close-up, shallow depth-of-field shot of several parallel titanium rods or wires. The rods are arranged diagonally, creating a strong sense of perspective. The lighting is dramatic, with bright highlights on the edges of the rods and deep shadows in the spaces between them. In the upper right corner, a portion of a titanium screw with a hexagonal head is visible, slightly out of focus. The overall color palette is a mix of metallic grays and warm, golden-brown tones.

Titanium

DISCOVERY

- Discovered first in 1791 by William Gregor (menachanite)
- In 1795 Martin Klaproth found an oxide of an unknown element (rutile) and named it titanium.
- The name is originated from Greek mythology, the sons of the Earth goddess, the Titans
- Pure titanium first made in 1910
- Industrial production began in 1948



ELEMENT

The 9th most abundant element on Earth

- In Earth's crust 0,63 %
- In universe 0,003 %

Has five naturally occurring, stable isotopes:

- 46 Ti
- 47 Ti
- 48 Ti
- 49 Ti
- 50 Ti

COMPOUNDS

Two most important minerals are ilmenite (FeTiO_3) and rutile (TiO_2)

The most used form of titanium is titanium(IV)oxide
~ 95 % of the titanium consumed

Naturally occurring forms require expensive processing to produce quality pigments

Three forms in room temperature:
Rutile, anatase & brookite

Has excellent covering power

Can prevent UV light from reaching the skin

Sulfate process and chloride process

COMPOUNDS

Halides

- Such as TiCl_4 :
 - Important intermediate in making of TiO_2
 - Used in production of Ziegler-Natta catalysts for ethylene polymerization

Complexes

- For example, "Organic titanates":
 - Thin, adherent and transparent coating of TiO_2 by exposure to the atmosphere

PRODUCTION

Titanium is light weight and high strength, therefore important as an alloying agent.

Exports of titanium mill products almost 107kt in 2019

The Kroll method:

Ilmenite or rutile is heated with chlorine and carbon



Distillation and reduction in a sealed furnace under Ar



- Because titanium requires inert atmosphere in the casting, it is expensive to produce

Specific functionalities and applications

- Titanium is used in probably every industry due to its mechanical properties
- Titanium dioxide thin films are antibacterial in UV light
- Titanium can be used in photocatalytic water splitting, chemical sensors and nanomedicine
- Black titanium dioxide is better photocatalyst due to its structure.
- Black TiO₂ can be manufactured via hydrogenation
 - 200 – 500 degrees Celsius, 20 bar for 1 h – several days

Bactericidal and Detoxification Effects of TiO₂ Thin Film Photocatalysts *Environ. Sci. Technol.* 1998, 32, 5, 726–728

Shedding light on black titania, *Nature materials*, Vol 17 October 2018, 851-859 .

Structural evolution of titanium dioxide during reduction in high-pressure hydrogen, <https://doi.org/10.1038/s41563-018-0135-0>

Specific functionalities and applications

- Titanium oxide metal frameworks used for CWA degradation
 - Titanium compounds' excellent ability to hydrolyze CWAs
- 2D Titanium carbide is used for thin applications such as wearable electronics
 - Electrical conductivity is 100-fold compared to MoS₂, and is an excellent conductor in thin form

References



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