

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



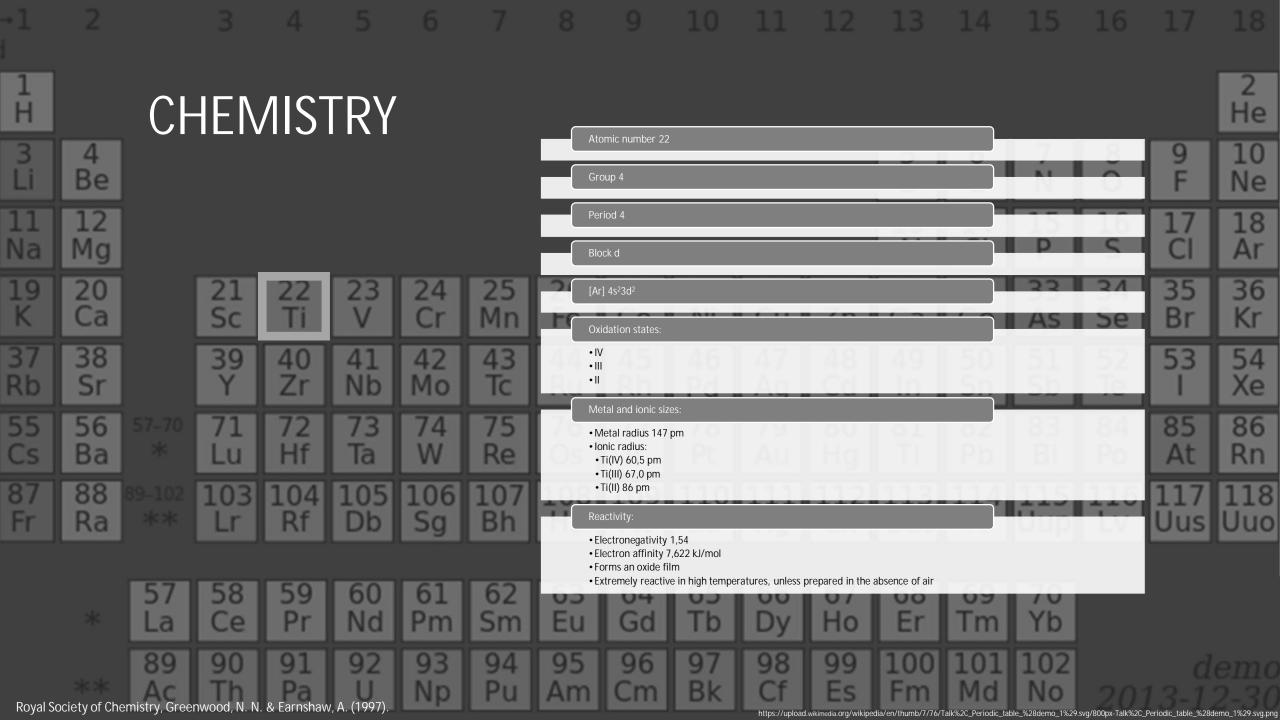
The 9th most abundant element on Earth

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

ELEMENT

Has five naturally occurring, stable isotopes:

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



COMPOUNDS

Two most important minerals are ilmenite (FeTiO₃,) and rutile (TiO₂)

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

Three forms in room temperature: Rutile, anatase & brookite

Has excellent covering power

Can prevent UV light from reaching the skin

Naturally occurring forms require expensive processing to produce quality pigments

Sulfate process and chloride process

COMPOUNDS

Halides

- Such as TiCl₄:
 - Important intermediate in making of TiO₂
 - Used in production of Ziegler-Natta catalysts for ethylene polymerization

Complexes

- For example, "Organic titanates":
 - Thin, adherent and transparent coating of TiO₂ 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

$$900^{\circ}\text{C}$$

2 FeTiO₃ + 7 Cl₂ + 6 C \rightarrow 2 TiCl₄ + 2 FeCl₃ + 6 CO

Distillation and reduction in a sealed furnace under Ar

$$700^{\circ}$$
C
TiCl₄ + 2 Mg \rightarrow Ti + 2 MgCl₂

 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 a can be manufactured via hydrogenation
 - 200 500 degrees Celsius, 20 bar for 1 h several days

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



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