

# Niobium

SKYLER CHANDLER

# General Information

- ▶ Atomic number 41
- ▶ Atomic mass 92.906
- ▶ Melting point 2477°C
- ▶ Boiling point 4744°C
- ▶ Density 8.57g/cm<sup>3</sup> at RT
- ▶ Only one stable isotope <sup>93</sup>Nb

# Appearance

- ▶ Grey metallic
- ▶ Becomes bluish when oxidized
- ▶ It has a cubic crystal structure



# Other Properties

- ▶ It oxidizes when exposed to the air
- ▶ It is corrosion resistant, but not as much as Tantalum
- ▶ Super conductor properties
- ▶ It can form a dielectric oxide layer

# History

- ▶ The first sample came from America and sent to England
- ▶ Was discovered in 1801 by Charles Hatchett
- ▶ William Wollaston decided in 1809 that there was no new element in the ore
- ▶ This was because the ore contained a similar element, tantalum, that had been discovered a few years before

# History

- ▶ It was rediscovered by Heinrich Rose in 1844
- ▶ He produced 2 different acids from columbite and tantalite
- ▶ Was first isolated as metallic niobium in 1864 by Jean Charles Galissard de Marignac

# Naming Controversy

- ▶ Was called Columbium after the Americas
- ▶ Columbium was the first name used and continued in America
- ▶ Niobium was the later name used in Europe
- ▶ Since the element often occurred with tantalum, the name became niobium
- ▶ Niobe was the daughter of Tantalus, the namesake of tantalum
- ▶ Tungsten had a similar issue, Wolfram in Europe and Tungsten in America

# Production

- ▶ Brazil controls much of the world's production
- ▶ Columbite ore, in which it was first found, is a good source of it
- ▶ Pyrochlore is also a major source of it
- ▶ The 2 largest deposits are found in Brazil
- ▶ The 3<sup>rd</sup> largest deposit is in Canada



# Production

- ▶ Columbite ore contains  $\text{Nb}_2\text{O}_5$  and  $\text{Ta}_2\text{O}_5$
- ▶ Nb can be separated from Ta using HF, resulting in complexes with different solubility
- ▶ Then separated with crystal fractionization
- ▶  $\text{Nb}_2\text{O}_5$  and  $\text{Fe}_2\text{O}_3$  together can be reduced to ferroniobium using Aluminum
- ▶  $\text{Nb}_2\text{O}_5$  by itself is reduced to Nb

# Compounds

- ▶ At high temperatures reacts with nonmetal
- ▶ It can react with fluorine at RT
- ▶ HF is one of the few acids it is attacked by
- ▶ Most commonly at oxidation state of +5

# Uses

- ▶ Some alloys of steel to make it harder and more heat resistant
- ▶ Used to make super conductors and so are some of its alloys
- ▶ The alloys are used in gas pipelines, jet turbines
- ▶ Some compounds are used in electroceramics

# Uses

- ▶ The element is not physiologically active and is used in jewelry
- ▶ When anodized can take many colors for jewelry
- ▶ It can be used in alloys in medical tools
- ▶ However some compounds of niobium are toxic, such as niobium pentachloride
- ▶ niobium pentachloride can be used to make organometals

# References

- ▶ <https://en.wikipedia.org/wiki/Niobium>
- ▶ <https://education.jlab.org/itselemental/ele041.html>
- ▶ <https://www.britannica.com/science/niobium>
- ▶ <http://www.rsc.org/periodic-table/element/41/niobium>