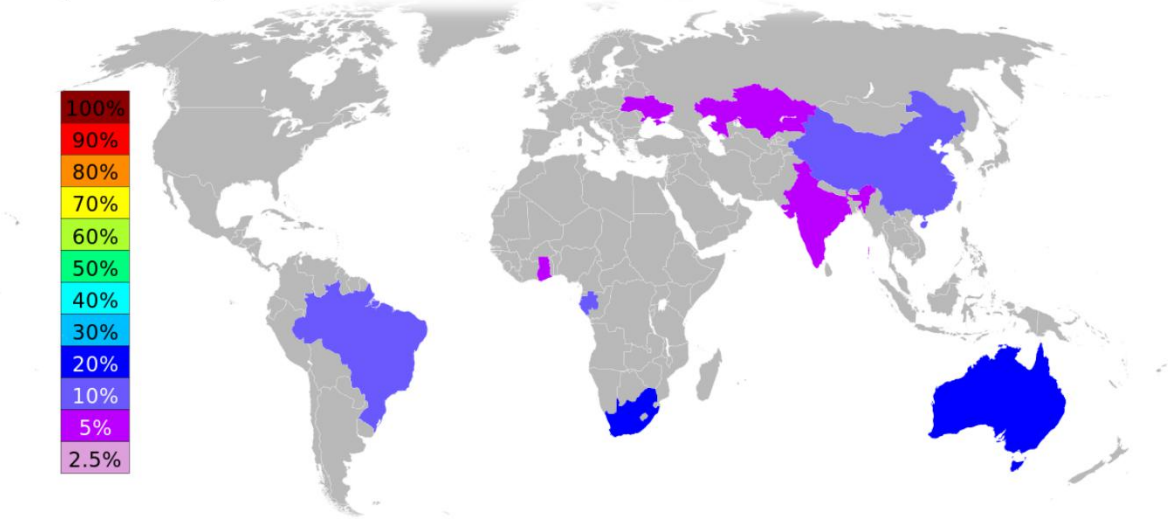
MANGANESE

Lu Wang – Tran Le

Discovery and use

- discovered by the Swedish pharmacist and chem
- First isolated the metal the Swedish chemist Jo
- The name derives from the Latin magnes for "ma
- 0.1% in the Earth's crust, ranking 12th in popularity of t
- The most important manganese ore is pyrolusite (MnO2).

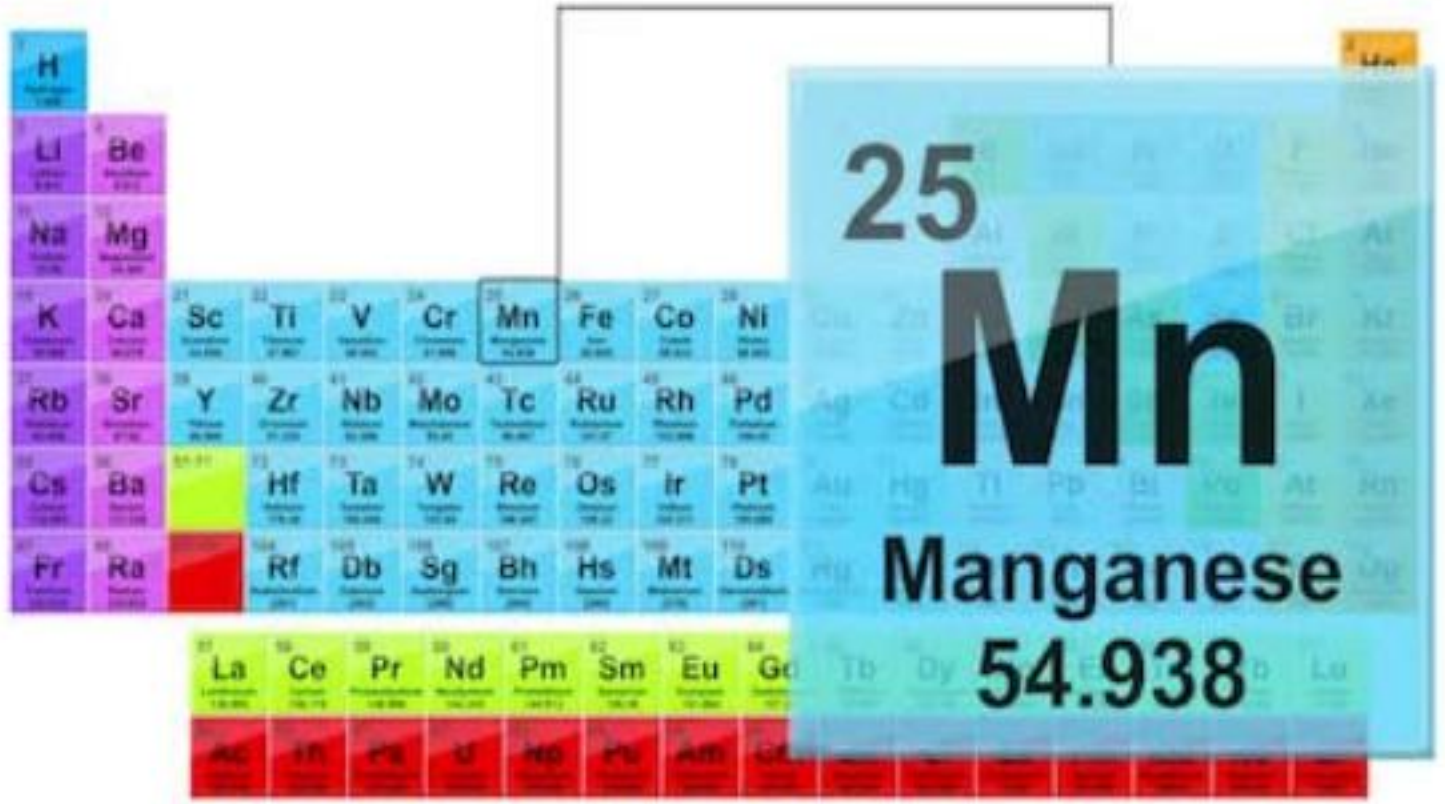


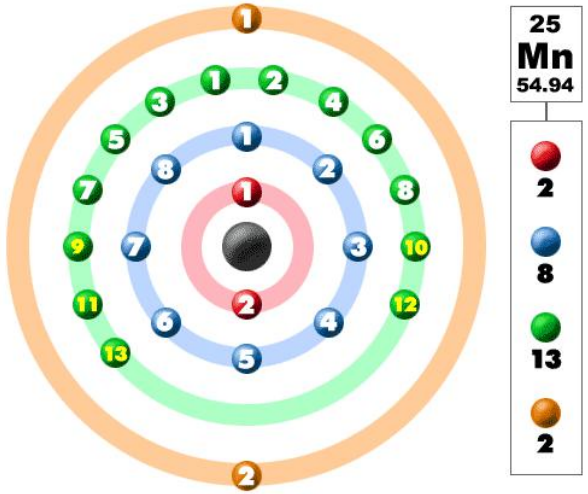
Rancke-Madsen, E. (1975). "The Discovery of an Element". Centaurus. 19,2020

Discovery and use

- 17th century, permanganate was discovered.
- 18th century, manganese dioxide used to produce chlorine.
- 19th century, used in steelmaking.
- 20th century, used as the cathodic for commercial disposable dry batteries.
- used as colorants and colorants for ceramics and glass.

Corathers, Lisa A. (2009). “Mineral Commodity Summaries 2009: Manganese” United States Geological Survey
Rancke-Madsen, E. (1975). "The Discovery of an Element". Centaurus. 19





- Transition metal
- Atomic number: 25
- Empirical Atomic Radius: 140 pm
- Group 7 , Period 4:
- d-block
- Electron configuration: [Ar] $4s^2$ $3d^5$

M. Bohlsen, A Look At The Manganese Sector And Some Of The Main Miners, 2019: http://seekingalpha.com/article

Chemical Properties

- silvery-grey metal ,
- hard and very brittle, easy to oxidize.
- One stable isotope of ^{55}Mn.
- The most stable radioisotopes: ^{53}Mn, ^{54}Mn and ^{52}Mn
- Manganese compounds (+7 oxidation state): are potent oxidizers.
- The most stable oxidation states are manganese +2
- The +3 oxidation state prone to disproportionation in solution, forming manganese(II) and manganese(IV).

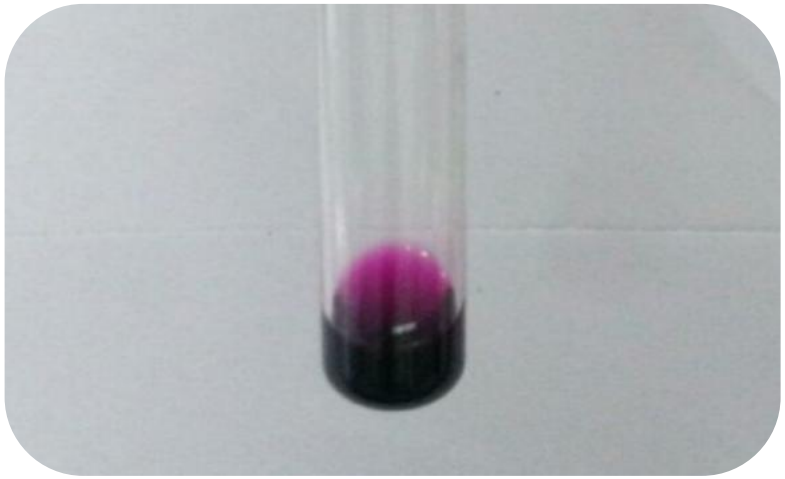
Oxidation states of manganese	
+2	$MnCl_2$, $MnCO_3$, MnO
+3	MnF_3, Mn_2O_3
+4	MnO_2
+7	$KMnO_4$, Mn_2O_7

Holleman, Arnold F.; Wiberg, Egon; Wiberg, Nils; (1985). “Mangan”. Lehrbuch der Anorganischen Chemie . Walter de Gruyter.page. 1110–1117
Rayner-Canham, Geoffrey and Overton, Tina Descriptive Inorganic Chemistry, Macmillan, 2003

Compounds

$KMnO_4$

potassium permanganate



MnO_2

manganese dioxide

$KMnO_4$ Mn(VII)

Strong Oxidizability (especially in acid)

- Used for sterilization
- Used for decolorization
- Used as strong oxidant in lab: to produce O_2 and Cl_2, etc.
- Reduced to different product in acidic/basic/neutral solution
- Easy to decompose when exposed to light and stored away from light
- Obvious colour : Acid potassium permanganate is an important titrant

MnO_2 Mn(IV)

- Exists in the form of pyrolusite in nature

  used to produce iron-manganese alloy
- Oxidizability

  $MnO_2 + 4HCl \text{——} MnCl_2 + Cl_2 + 2H2O$
- Reducibility

  $3MnO_2 + 6KOH + KClO_3 \text{——} 3K_2MnO_4 + KCl + 3H_2O$
- React with both concentrated acid and concentrated base

  $MnO_2 + 4HCl(concentrated) \text{——>} MnCl_4 + 2H_2O$

  $MnO_2 + 2NaOH(concentrated) \text{——>} Na_2MnO_3 + H_2O$
- used as catalyst
- used as the electrode of battery

Specific functionalities/applications

Efficient supercapacitor material: MrG nanocomposite

- MrG: Introduce MnO_2 into reduced graphene oxide (rGO) sheets
- MnO_2 nanosheets contains crystal water and oxygenous group
- Zeta potential of GO and MnO_2 were both negative
- Homogeneous lamellar structure of MnO_2 and rGO was formed.
- Benefiting from the synergistic effect of rGO and MnO_2
- MrG show excellent capacitive performance

Reference: Y. Yu et al. / Materials Letters 176 (2016) 33–37

Specific functionalities/applications

- Excellent Hg^0 removal capacity:

  Ce-Mn co-modified activated carbon catalyst
- Mix MnO_X into CeO_2
- A solid solution between manganese and cerium oxide formed
- Promoted the conversion of Hg^0
- Ce-Mn modification made chemisorption overweight physisorption

Reference: J. Wu et al. / Catalysis Communications 93 (2017) 62–66

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Thanks for your listening!