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CONSTRUCTION AND WORKING OF INDICATOR ELECTRODES

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INDICATOR ELECTRODE

The electrode is used to measure the potential of a solution to which it is dipped inside along with reference electrode.

- 1. Metal Electrode**
- 2. Hydrogen electrode**
- 3. Quinhydrone electrode**
- 4. Glass Membrane Electrode**



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METAL INDICATOR ELECTRODES

Metal electrode develops electric potential as a result of redox reaction at its surface.

- 1. First Order Electrode -A first order electrode involves the metal in contact with its own ions, such as Ag, Ag⁺ or Zn, Zn. $\text{Ag}^+ + \text{e}^- \leftrightarrow \text{Ag (s)}$, $E = 0.800$**

Limitation:

- **metallic indicator electrodes are not very selective and respond not only to their own cations but also to other more easily reduced cations.**
- **Many metal electrodes can be used only in neutral or basic solutions because they dissolve in the presence of acids**



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2. A second-order electrode –

- one that responds to the presence of precipitating or complexing ions.
- For example, silver wire could serve as the indicator electrode for chloride. $\text{Ag} + \text{Cl}^- \leftrightarrow \text{AgCl} + \text{e}^-$, $E = 0.199$

3. Inert Electrode-

- The most commonly used indicator electrodes are known as inert
- These electrodes are not involved in the half-cell reactions of the electrochemical species.
- Typical inert electrodes are platinum, gold, and carbon. Inert electrodes are responsive to any reversible redox system; these are widely used in potentiometric work.



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GLASS MEMBRANE ELECTRODE

- Its most commonly used indicator electrode
- It involves Ion Exchange reaction
- Membrane is made up of chemically bonded Na_2O , SiO_2 and Al_2O_3
- The Glass bulb is filled with solution of HCl & KCl , silver acetate coated with AgCl is inserted as Electrode

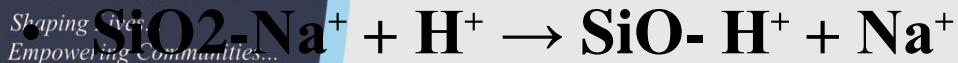
Working

- First glass absorb water
- Then H^+ ions can move in the direction of lesser concentration and replace Na ions and others in the glass membrane.



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- As a result of diffusion and exchange process a potential develops on each side of glass membrane

Applications

- Its potential is not effected by the presence of strong reducing and oxidizing agents.
- It operates over a wide pH range,
- It respond fast and function well in physiological systems
- Used in pH meter.



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HYDROGEN ELECTRODE

- **Used in acid base titration but very limited application because many organic substances directly react with hydrogen gas**

QUINHYDRONE ELECTRODE

- **Contain a solution of Quinones and Hydroquinones prepared from Quinhydrone**
- **$2QH \rightarrow Q+H_2Q$**
- **Simple and easily attains equilibrium**
- **employed in the presence of mild oxi and red agents at pH8**
- **Sensitive to high conc of salts and oxi & red agents.**



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- **The electrode consists of an inert metal electrode (usually a platinum wire) in contact with quinhydrone crystals and a water-based solution.**
- **Quinhydrone is slightly soluble in water, dissolving to form a mixture of two substances, quinone and hydroquinone, with the two substances present at equal concentration.**
- **Each one of the two substances can easily be oxidised or reduced to the other.**
- **The potential at the inert electrode depends on the ratio of the activity of two substances (quinone- hydroquinone), and also the hydrogen ion concentration. The electrode half-reaction is:**
Hydroquinone \leftrightarrow Quinone + 2H⁺ + 2e⁻



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THANK YOU