



SNS COLLEGE OF TECHNOLOGY
Coimbatore-35
An Autonomous Institution



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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF BIOMEDICAL ENGINEERING

19BMT202– BIOMEDICAL SENSORS AND MEASUREMENT

II Year / III Semester

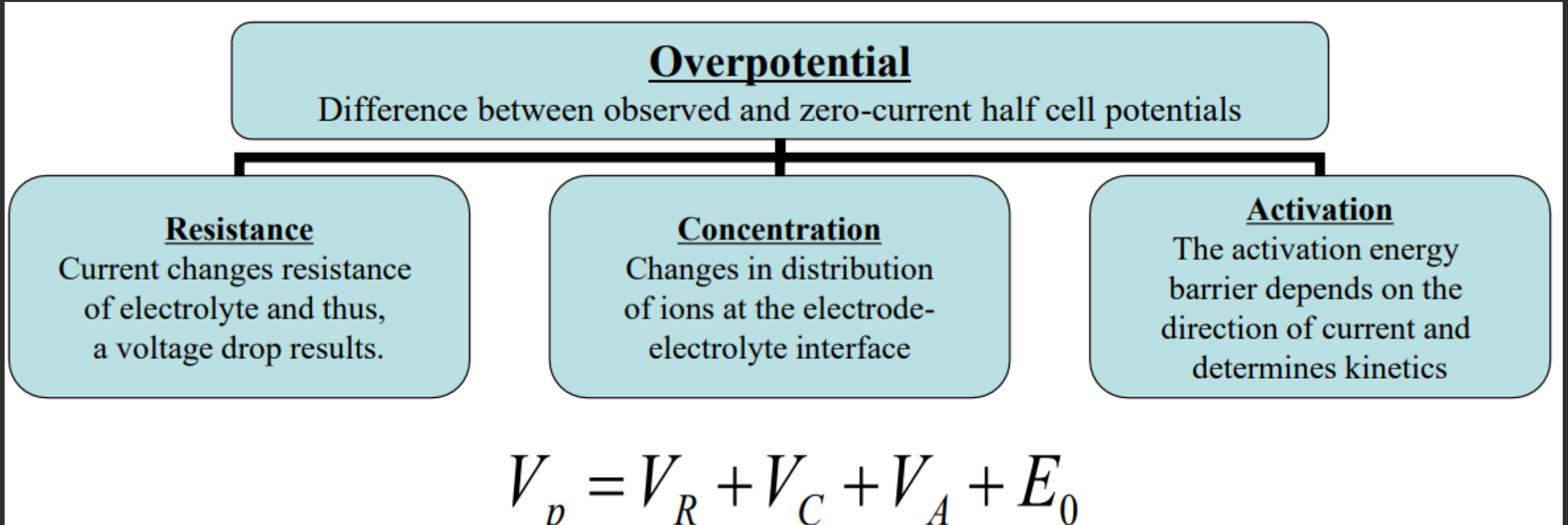
Unit 3 – BIOPOTENTIAL ELECTRODES & CONFIGURATION

Topic :Polarization

Welcome you all Design Thinkers to Today's Class



POLARIZATION

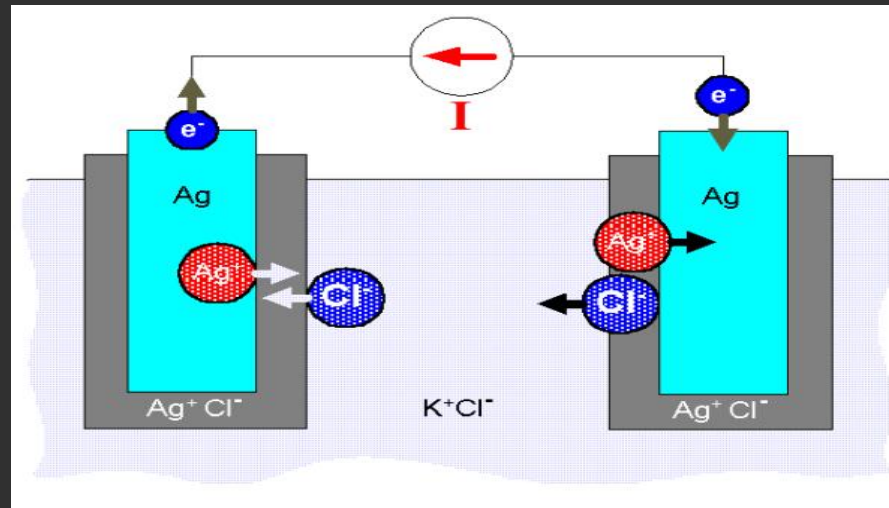


➤ Note: Polarization and impedance of the electrode are two of the most important electrode properties to consider



OHMIC OVERPOTENTIAL

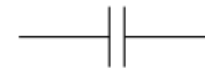
- Direct result of the resistance of the electrolyte.
- When a current passes between two electrodes immersed in an electrolyte, there is a voltage drop along the path of the current in the electrolyte as a result of its resistance.
- This drop in voltage is proportional to the current and the resistivity of the electrolyte





DIFFERENCES

Perfectly Polarizable Electrodes



*Use for
recording*

These are electrodes in which **no current crosses the electrode-electrolyte interface** when a current is applied. The current across the interface is a **displacement current** and the electrode behaves like a capacitor.

Example: Platinum Electrode (Noble metal)

Perfectly Non-Polarizable Electrode



*Use for
stimulation*

These are electrodes where **current passes freely across the electrode-electrolyte interface**, requiring no energy to make the transition. These electrodes see **no overpotentials**.

Example : Ag/AgCl electrode



POLARIZABLE AND NON-POLARIZABLE ELECTRODES



- No electrode is perfectly polarizable or non-polarizable.
- Platinum electrodes are a reasonable approximation of perfectly polarizable electrodes.
- They exhibit V_p that primarily results from V_c and V_a .
- Used for stimulation and for higher frequency biopotential measurements.
- Ag/AgCl electrodes behave reasonably closely to perfectly non-polarizable electrodes.
- They exhibit V_p that primarily results from V_r only.
- Used for biopotential recordings that range from high frequency to very low frequency.



ACTIVATION OVERPOTENTIAL



- The charge-transfer processes involved in the oxidation–reduction reaction are not entirely reversible.
- In order for metal atoms to be oxidized to metal ions that are capable of going into solution, the atoms must overcome an energy barrier which governs the kinetics of the reaction.
- The reverse reaction in which a cation is reduced, thereby plating out an atom of the metal on the electrode—also involves an activation energy, but it does not necessarily have to be the same as that required for the oxidation reaction.
- When there is a current between the electrode and the electrolyte, either oxidation or reduction predominates, and hence the height of the energy barrier depends on the direction of the current.
- This difference in energy appears as a difference in voltage between the electrode and the electrolyte, which is known as the activation overpotential.



POLARIZATION



- Note: for a metal electrode, 2 processes can occur at the electrolyte interfaces: – A capacitive process resulting from the redistribution of charged and polar particles with no charge transfer between the solution and the electrode – A component resulting from the electron exchange between the electrode and a redox species in the solution termed faradaic process.



MOTION ARTIFACT

- If a pair of electrodes is in an electrolyte and one moves with respect to the other, a potential difference appears across the electrodes known as the motion artifact.
- This is a source of noise and interference in bio-potential measurements.
- When the electrode moves with respect to the electrolyte, the distribution of the double layer of charge on polarizable electrode interface changes. This changes the half-cell potential temporarily.
- Note: Motion artifact is minimal for non-polarizable electrodes (Measurement electrodes – AgCl).

A top-down photograph of a white card with the words "Thank you" written in purple cursive. The card is placed on a light-colored marble surface. To the left of the card is a bouquet of small purple flowers with green leaves. To the right of the card is a black pen with a white polka-dot grip. Further to the right is a small gift wrapped in white paper with a grey polka-dot pattern, tied with a red and white striped string. A spool of this same string is visible in the top right corner.

Thank
you