

Micro Electrodes:

Micro electrodes are divided into metallic and non-metallic. The microelectrodes should have smaller diameter and during insertion of the electrode into cell, there will not be any damage to the cells. When a microelectrode is used to measure the potential of the cell, it is located within the cell, while the reference electrode is suited outside the cell.

The size of the electrode is determined by the size of the cell. Since the size of the cells is about 50 microns, the diameter of the tip of the microelectrodes is ranging from 0.5 to 5 microns. There are two types of micro electrode,

- Metallic electrode
- Non-metallic electrode

Metal microelectrode:

Metal microelectrodes are formed by electrolytically etching the tip of a fine tungsten or stainless-steel wire to a fine point. This technique is known as electro pointing. The metal electrodes are located almost to the micro tip with an insulating material. To reduce the impedance, some electrolytic processing like chloriding the tip and then developing by the photographic developer can be performed.

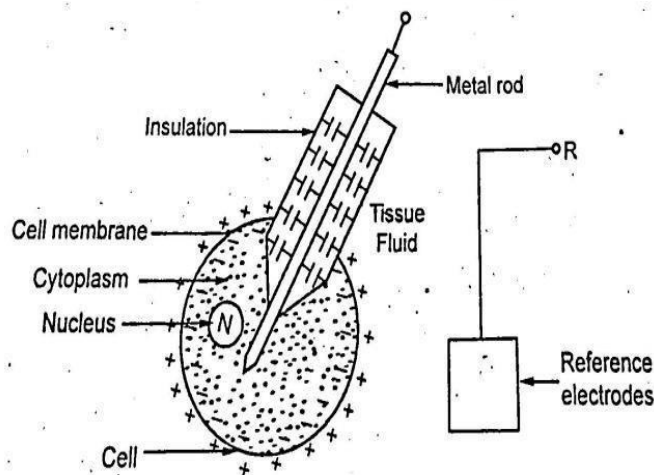


Fig: Portion of Electrode

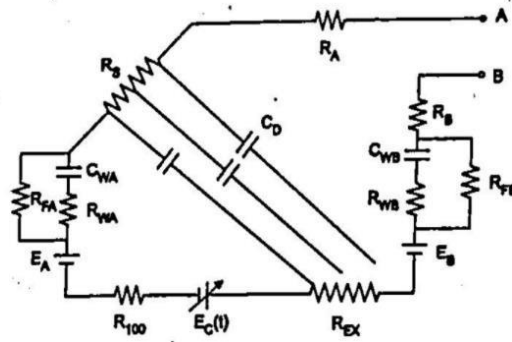


Fig: Electrical equivalent circuit

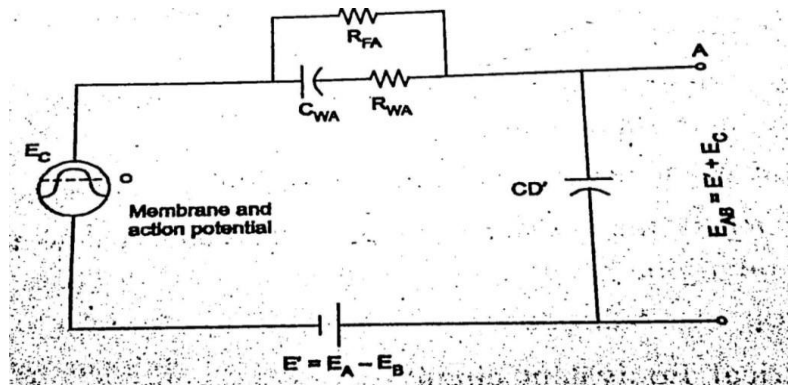


Fig: Metal micro electrode

Since the measurement of bioelectric potential requires two electrodes. The voltage measured is really the difference between the instantaneous potentials of the micro electrode and the reference electrode and it is the sum of three potentials as shown in figure such that

Where

E_A – Metal electrode-electrolyte potential at the microelectrode tip

E_B – Reference electrode-electrolyte potential

E_C – Variable cell membrane potential

N – Nucleus

C – Cytoplasm

The capacitance between the tip of the micro electrode and intra cellular fluid is negligible because the potential difference across it does not change. Since the area of the reference electrode is many times greater than the metal electrodes tip whose area of cross section is very small, its impedance is negligible. The impedance of the micro electrode tip is inversely proportional to the area of the tip and frequency.

When the electrode output is coupled with an amplifier, the low frequency components of the bio electric potential will be attenuated if the input impedance of the amplifier is not high. Thus, when the input impedance of the amplifier is not high enough, it behaves as a high pass filter.

Micropipet:

Non-metallic metro electrode is called micropipet. The non-metallic micropipet is filled with an electrolyte usually 3M KCl which is compatible with the cellular fluids. The non-metallic micropipet consists of a glass micropipet whose tips diameter about 1 micrometer.

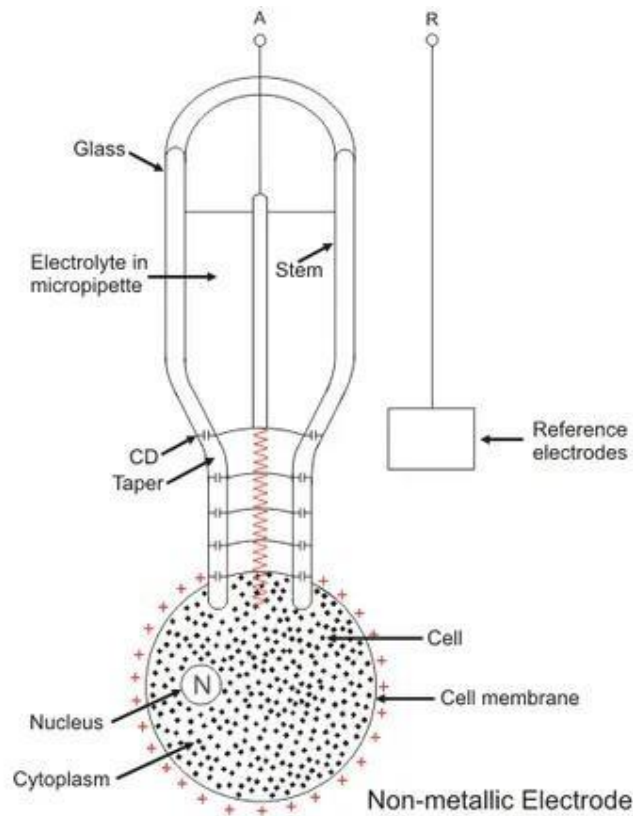


Fig: Micropipet electrode

A thin, flexible metal wire form chloride silver, stainless steel or tungsten is inserted into the stem of micropipet. The friction between the wire and the stem of the micropipet and the fluid surface tension hold the micropipet on the wire. The other end of the metal wire is mounted to a rigid support and the free end of resting on the cell.