

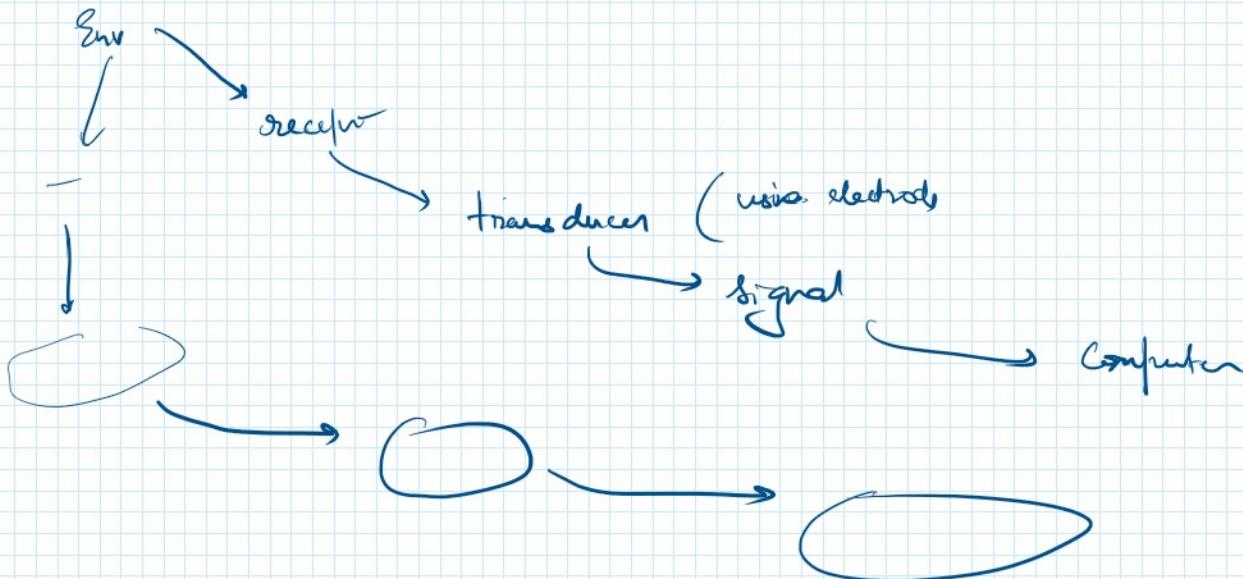
5. Sensors, Types of Sensors

17 November 2023 08:59

SENSORS

- Detects and responds to some certain types of inputs from the environment

Input examples: Moisture, molecules, light, heat, gas etc.



TYPES OF SENSORS

S: Semiconductor sensor

Eg: solar cells

O: Optical sensor

Eg: Ga-As, Ge-Si, photodetector sensor

M: Mass-sensitive sensor

Eg: Piezo device

E: Electrochemical sensor

Eg: O₂ sensor, glucose sensor

C: Conductivity sensor

Eg: Pt electrode

C: Capacitive sensor

Eg: Touch screens, polycarbonate, polyester

C: Calorific sensor

Eg: Bomb calorimeter

T: Thermosensitive sensor

Eg: Thermostat

ELECTROCHEMICAL SENSORS

Potentiometric (measures voltage)

Amperometric (measures current)

Electrochemical bio sensor
Eg. glucose sensor

CHECK
not sure if this
is a ...

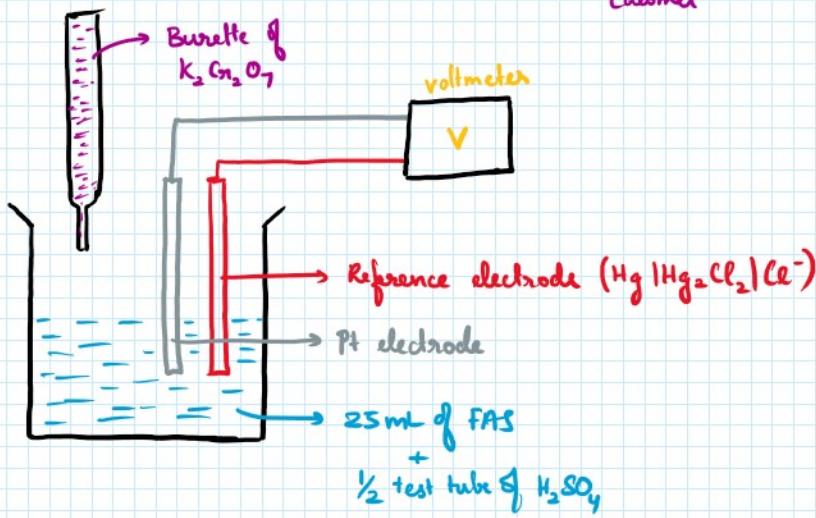


POTENTIOMETRIC SENSOR

- Measures voltage
- 2 electrode system

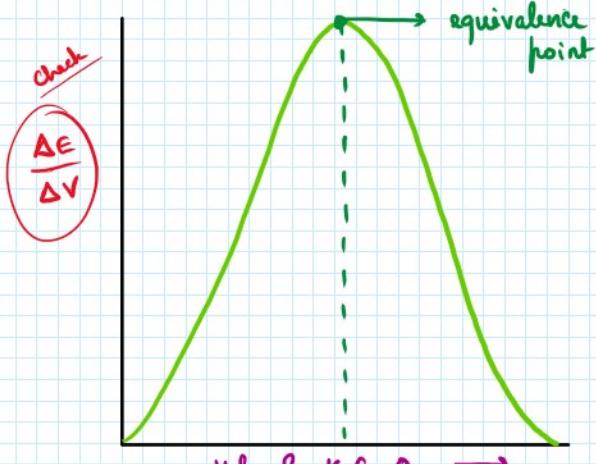
Analyte → Receptor → Transducer → Signal → Computer

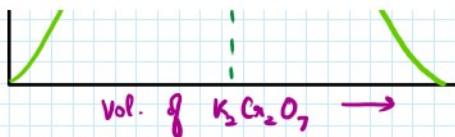
→ Pt electrode
 → Reference electrode
 Eg: Ag-AgCl
 Calomel



Onid .

Red -





Advantages

- Accurately measure voltage
- Simple
- Qualitative and quantitative measurements

Disadvantages

- Calibration
- Variation in temperature causes change in value of voltage measured

O₂ SENSOR (solid oxide sensor) (potentiometric sensor)] → check classification

Applications

- I.C. engines
- Medical applications
 - respiration
 - anaesthesia
- Deep sea divers

Anode: Pt

Cathode: Pt

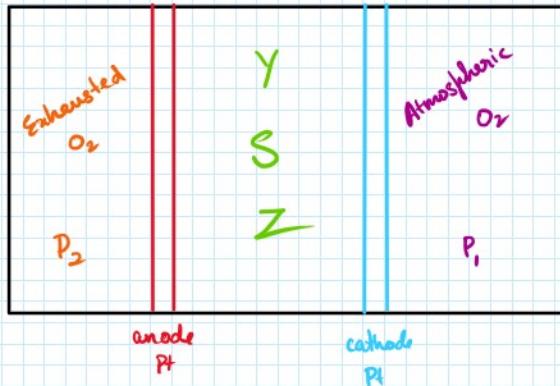
Electrolyte: Ceramic material : YSZ → releases O²⁻ ions

Yttria Stabilised Zirconia

ZnO₂ doped with Y₂O₃

Operating temp.: 360°C

- Air:fuel = 14.7:1] → for ideal engine
- Ideal voltage = 0.45 V
- Using lead-free gasoline



$$E_{\text{cell}} = \frac{2.303RT}{nF} \log \frac{P_1}{P_2}$$

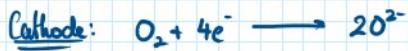
atmospheric O_2
exhausted O_2

At 25°C,

$$E_{\text{cell}} = \frac{0.0591}{n} \log \frac{P_1}{P_2}$$

atmospheric O_2
exhausted O_2

Equations



Rich mixture (less O_2) $\longrightarrow 0.8V$ (emission of CO_2 , unburnt C)

Lean mixture (more O_2) $\longrightarrow 0.2V$ (emission of NO_x gases)

Disadvantages

- Tailpipe emission
- Hesitation on acceleration

AMPEROMETRIC SENSOR

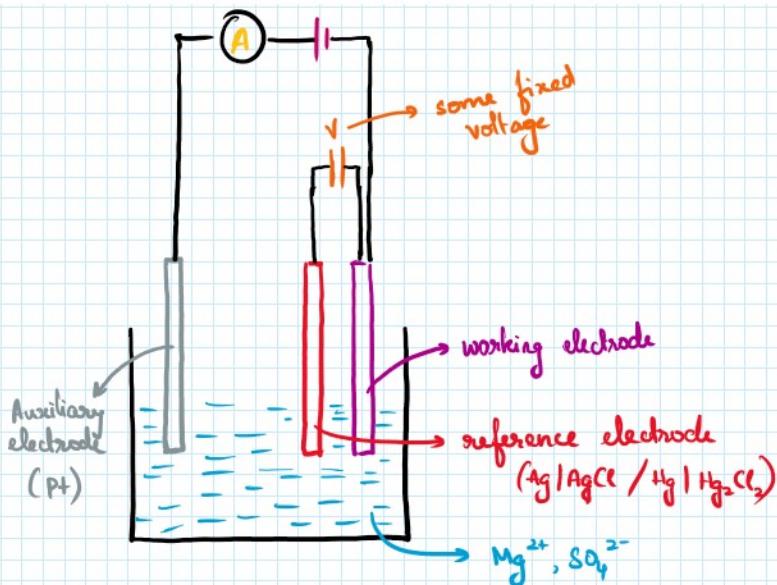
- Measures current

- 3 electrode system

Analyte \longrightarrow Receptor \longrightarrow Transducer \longrightarrow Signal \longrightarrow Electronic display

↳ Working electrode
 ↳ Reference electrode [Ag/AgCl, calomel]
 ↳ Auxiliary electrode

Ammeter



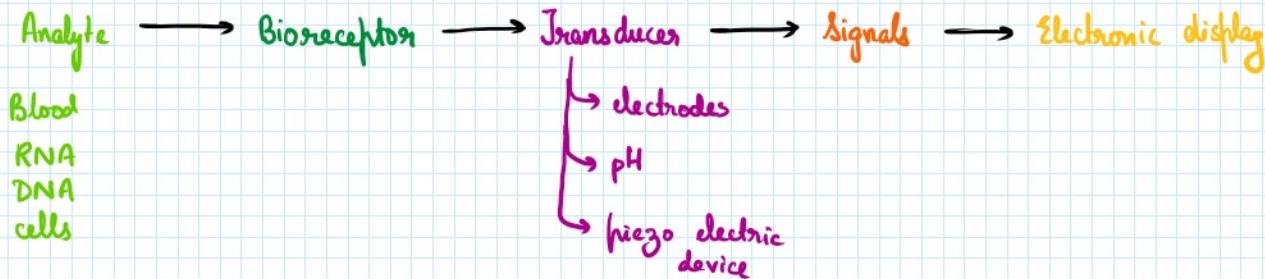
Advantages

- Simple to construct
- Qualitatively and quantitatively measure

Disadvantages

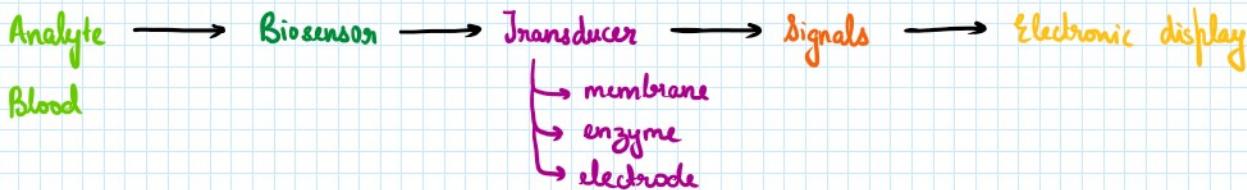
- -ve voltage leads to errors due to liberation of H_2

BIOSENSOR



GLUCOSE SENSOR

- Amperometric sensor



Blood

HIGH glucose → hyperglycemia
LOW glucose → hypoglycemia

