CHEMFET TRANSDUCERS

The operation of the chemical field-effect transistor (ChemFET) transducer is similar to the operation of a standard metal-oxide-semiconductor field-effect transistor (MOSFET). ChemFETs are miniature transducers that are used for the measurement of the concentration of certain gases and for the determination of hydrogen ion concentrations (pH).

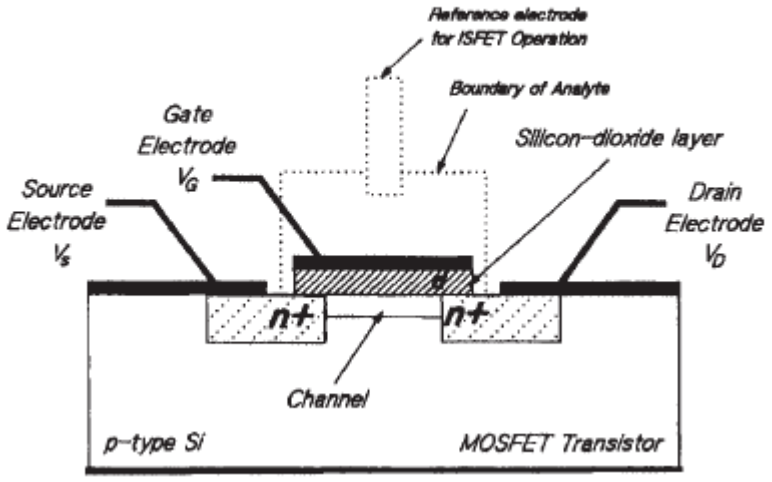

Fig 5.17 A cross section of a conventional MOSFET device.

Above the channel modulates ID as a function of the gate voltage VG. The VD vs. ID characteristics of a MOSFET as a function of VG display a linear region, and for small values of VD and ID, the channel behaves as a resistor.

The transduction mechanism in a MOSFET is basically to sense the charge on the gate electrode and then use that charge to modulate the flow of charges in the channel between the source and the drain.

The Chem FET uses a modification of the MOSFET transduction mechanism.37 The palladium (Pd) gate MOSFET for hydrogen gas sensing and the ion-sensitive FET (ISFET) are two important examples of ChemFET transducers. In the Pd gate FET transducer the aluminum gate electrode is replaced by a Pd gate. Molecular hydrogen (measurand), in the air or by itself, is absorbed at the Pd surface, where it undergoes a catalytic dissociation into atomic hydrogen (Ha).

The atomic hydrogen then diffuses through the bulk of the Pd electrode and forms a dipole layer at the Pd-SiO2 interface.The polarization caused by the dipoles modulates the channel current ID in direct proportion to the hydrogen ion concentration.

In another ChemFET, a 10-nm-thick platinum film evaporated on top of the Pd gate electrode enables the measurement of ammonia (NH3) concentraton. If, instead, the gate electrode is a perforated film of platinum, the ChemFET will measure carbon monoxide.

The ISFET does not have a gate electrode and the SiO2 gate dielectric is exposed directly to the aqueous solution or the analyte whose pH is to be determined.

For proper operation, an electrode is placed in the analyte and referenced to the bulk semiconductor. The transduction mechanism here is the formation of a charge at the analyte-oxide interface which is proportional to the pH of the analyte. This charge then modulates the channel current ID, and the electrical output of the ISFET is proportional to the pH of the analyte.

Source: http://mediatoget.blogspot.in/2012/06/chemfet-transducers.html