Basic Principles of Sensors for the Detection of Formaldehyde

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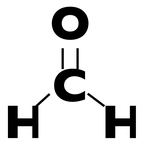
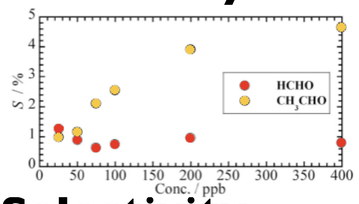
Formaldehyde (HCHO)



Formaldehyde is used in a variety of manufactured products including glues, fabrics, resins, plywood, and insulating materials. It can be absorbed through the skin and eyes or inhaled, which may cause eye, nose and throat irritation, breathing difficulties, coughing, sneezing, nausea, and potentially death (WHO, 2001).

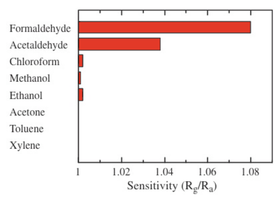
Sensitivity



A sensitivity below 0.08 ppm is required for the detection of HCHO (WHO, 2001).

(Itoh et al., 2007)

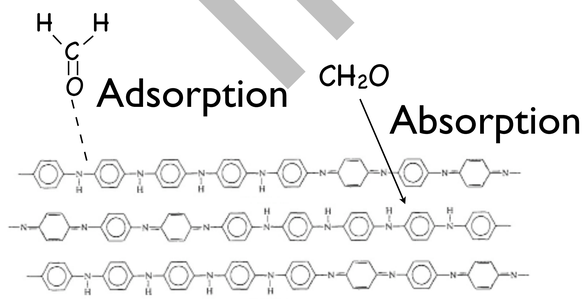
Selectivity



High selectivity is important for a sensor. Polyaniline (PANI)/MoO_3 hybrids had high sensitivity to HCHO, but also moderate sensitivity to acetylaldehyde, thus the sensor had poor selectivity (Wang et al., 2006).

Absorption and Adsorption

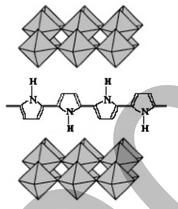
HCHO absorbs and adsorbs onto the sensing film.



Desirable Sensor Features

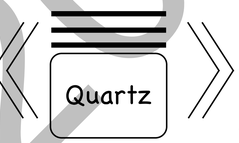
A sensor must be able to selectively detect HCHO below 0.08 ppm, at a temperature between 15°C and 30°C, over a short period of time. The sensor should be able to be stored at room temperature, be able to be regenerated before use, and not react with HCHO during storage.

Conductive Polymer Sensors



Polymer-based sensors consist of an organic/inorganic thin film made up of intercalated layers of conductive polymer with a semiconducting material. The thin film is placed in a circuit and the change in resistance caused by the absorption of the analyte onto the film (Hosono et al., 2005).

Quartz Crystal Microbalance (QCM) Sensors



The change in frequency caused by the added mass of the analyte is measured. A thin film of sensing material is adhered to the QCM and the analyte absorbs.

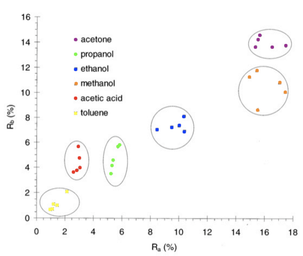
Non-polymer-based Sensors

Kawamura et al. (2005) developed a sensor that used 4-amino hydrazine-5-mercapto-1,2,4-triazole (AHMT) to detect HCHO via a colour change.

Biosensors

Biosensors use biological molecules like enzymes to bind selectively to target analytes; however, for the enzymes to remain active, they must be kept in solution at a specific pH (Mitsubayashi and Hashimoto, 2002).

Electronic Noses



Electronic noses consist of sensor materials that have partial selectivity for many analytes. The sensor is combined with a pattern recognition program which identifies these analytes (De Wit et al., 1998).

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