Chapter — 6

Summary
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SUMMARY

The present work has been carried out using the sensing phenomena with Bioelement and Semiconductor material to develop a Biosensor and Gas sensor respectively. All the useful information about a physical event can be obtained, if the sensor provides a signal that has a direct relationship with the quantity under investigation. If simplicity and speed are crucial, then a direct indicating procedure is employed. Direct detection is highly attractive for basic and applied research. The exact concentration profile depends on the analyte to be determined.

Any natural event is characterized by certain properties, which can be exploited for its identification using biodetection methods. The information decoded by the bioreceptor is converted into an electrical signal by the transducer (the device is called as Biosensor) using measuring techniques like potentiometry, amperometry, thermometry or photometry, all of which are based on the variation of physical quantities. The potentiometric method has been adopted for all the measurements of biosensors because the method chosen is simple, effective and of reasonable size, so that it becomes easy to use. In potentiometric analysis, enzyme reaction and the detection of the
product occur at the same interface. Electrical potential is determined at very high impedance allowing effectively zero current flow and causing no interference in reaction due to the high input impedance meter.

The thesis incorporates the results of investigations carried out on urea biosensors and ammonia gas sensors and is divided into six different chapters.

The work, which has already been carried out on Biosensors and Gas sensors, are reported in chapter 1. The working principle of a biosensor has also been included in this chapter. The importance of the work on biosensor to detect urea in milk has been highlighted, taking into the consideration the reasons for adulteration in milk and the ill effect of urea adulteration on health of the consumers.

Ammonia is a hazardous gas and its detection and quantitative measurement of ammonia in environment are important for a better environment. The aim of the work and the reasons for selecting this problem are also discussed in chapter 1.

Chapter 2 describes in details the method of fabrication of urea biosensor starting from screen printing of electrodes on polyester sheet, laminating the fabricated electrodes followed by immobilization of
enzyme urease in the Poly (carbomylsulphonate) (PCS) and Polyethyleneimine (PEI) gel as a matrix in length. The biosignals obtained by an enzymatic hydrolysis reaction of urea in biosensor have been measured using potentiometric method. The reasons for selecting this particular electrochemical transducer have been discussed.

The biosensors fabricated have been characterized with response to urea concentration. The results obtained are discussed in chapter 3. The sensitivity of the urea biosensor to detect different concentration of urea has been checked against standard solutions. The results obtained from urea biosensors are compared with results obtained from standard method already in practice. The characterization of the biosensor is very important for meaningful results. The parameters like linearity, reproducibility, shelf life, temperature dependence, effect of pH, specificity etc. have been checked and discussed. The other factors affecting the performance of urea biosensors have also been discussed.

Chapter 4 contains the results of urea analysis in milk for many different samples. Different methods of urea estimation have been indicated, also the names of commercially available instruments have been listed. The urea biosensors when dipped into the sample i.e. milk, then the potential difference generated due to enzymatic reaction with urea in the sample is measured across the two electrodes, namely reference and working
electrode by pH/ISE/mV meter. The results obtained using urea biosensors are comparable to results obtained with spectrophotometric method. The advantage of the urea biosensors over the said method is that it is easy to handle, requires less sample preparation time and layman can easily operate and measure the concentrations. The biosensor strips are very cheap and if fabricated in large scale the cost can be further reduced.

The evaluation of any material in its thin film form is complete meaningful only when its structure and composition are known. Depending on the requirements of application, properties of thin films can be modified and this can be assured through a systematic study of growth, electrical and optical properties of the deposited films. These aspects were considered in details during the deposition of Indium Oxide thin films. Indium Oxide thin film and Indium Tin Oxide miniature heater was used to fabricate Ammonia gas sensor. The results are discussed in chapter 5. All valence molecular orbital calculations have been carried out for a number of pollutants including Ammonia to obtain a correlation between the sensitivity of the pollutants towards the sensor and with some molecular index. The sensitivity of Ammonia is not high at room temperature. Only at high temperature gas is sensed. Attempts have been made to explain this in this chapter.

The whole work is summarized in chapter 6.