ABSTRACT

This thesis aims at, fabrication and characterization of enzyme modified field effect transistors (ENFETs) for detection of cholesterol and acetylcholine using solution technique.

In the first work, cholesterol oxidase (ChOx) has been immobilized on the polyaniline (PANI)/zinc oxide (ZnO) based sensing membrane of a junctionless carbon nanotube field effect transistor (JLCNTFET) by physical adsorption technique for cholesterol detection. The JLCNTFET has been fabricated on indium tin oxide (ITO) glass plate. Electrical response has been recorded for cholesterol concentration from 0.5 to 22.2 mM using digital multimeter (DMM) in presence of phosphate buffer saline (PBS) of 50 mM, and pH 7.0 contained in a glass pot. Studies on response for cholesterol show linearity from 0.5 to 16.6 mM and improved sensitivity of 60 mV/decade. The shelf life of this sensor has been found to be 5 month (under test) and response time of 1s. The Michaelis–Menten constant (K_m) and Limit of detection (*LoD*) were found to be ~1.4 and 0.2 mM, respectively. The results in this work show negligible interference with glucose, uric acid and urea.

In the second work, acetylcholine esterase (AChE) has been immobilized on chitosan (CH)/nickel oxide (NiO) based sensing membrane of a dual–gated JLCNTFET (DG–JLCNTFET) using physical adsorption technique for detection of acetylcholine. The DG–JLCNTFET has been fabricated on ITO coated glass plate. The response of this device has been carried out for acetylcholine from 0.01 to 0.2 mM using DMM in presence of PBS of 50 mM & pH 7.0 in a glass pot. The results show good linearity for acetylcholine concentration from 0.01 to 0.2 mM and improved sensitivity of 1.25 V/decade. *LoD* and K_m have been found to be 0.37 μM and 0.2 mM, respectively. Insignificant interference observed with other clinical parameters.

In the third work, comparison has been studied between the results obtained in the first work (JLCNTFET) and a graphene based traditional FET for detection of cholesterol. For

this, ChOx has been immobilized using physical adsorption technique on a sensing membrane consisting of polypyrrole (PPy) with potassium (K)–doped CNT of a traditional graphene based FET (g–FET). The g–FET has been fabricated on ITO coated glass using electrochemical deposition technique. The response of PPy/K/CNT/g–FET has been studied using DMM in presence of PBS of 50 mM and pH 7.0 contained in a glass pot for cholesterol concentration from 0.5 to 25 mM. It has been found that PPy/K/CNT/g–FET has linearity from 0.5 to 20 mM. The sensitivity has been found to be ~58 mV/decade. The sensor has response time of 1 second and stability up to 6 months. K_m and *LoD* were found to be 2.5 and ~1.4 mM, respectively. The results show negligible interference with other clinical parameters.

Graphically, the abstract for the three works has been represented by the following figures and graphs. **Fig. 1** represents the structure and sensitivity graph for cholesterol detection using JLCNTFET. **Fig. 2** represents the structure and sensitivity graph for acetylcholine detection using DG–JLCNTFET. **Fig. 3** represents the structure and sensitivity graph for cholesterol detection using g-FET. The graphical abstract show that DG–JLCNTFET has maximum sensitivity, low *LoD* and low K_m for acetylcholine detection. It is also found that JLCNTFET shows high sensitivity, low *LoD* and low K_m as compared to the graphene based FET for cholesterol detection.

Graphical Abstract:

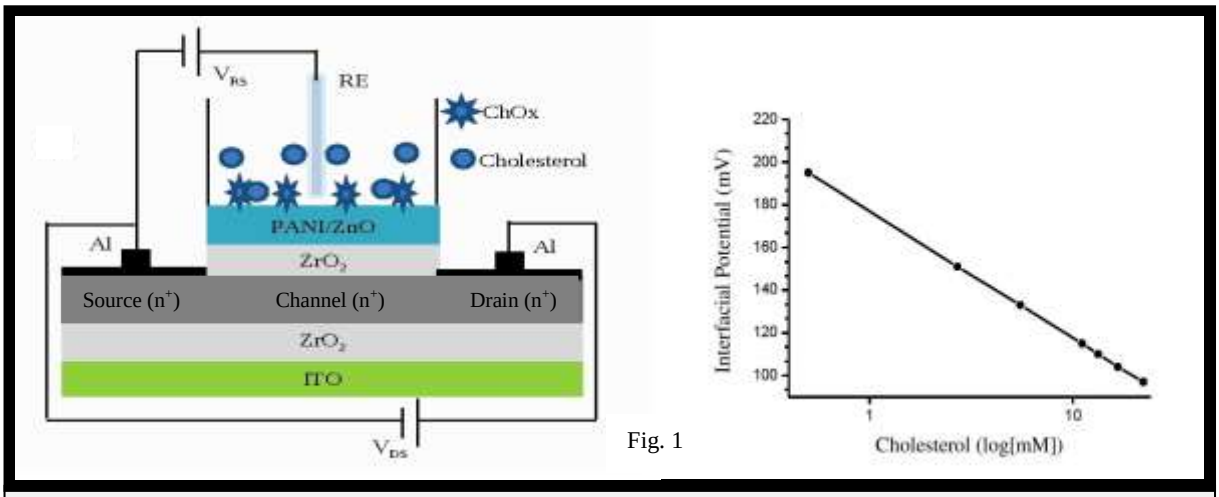

Fig. 1

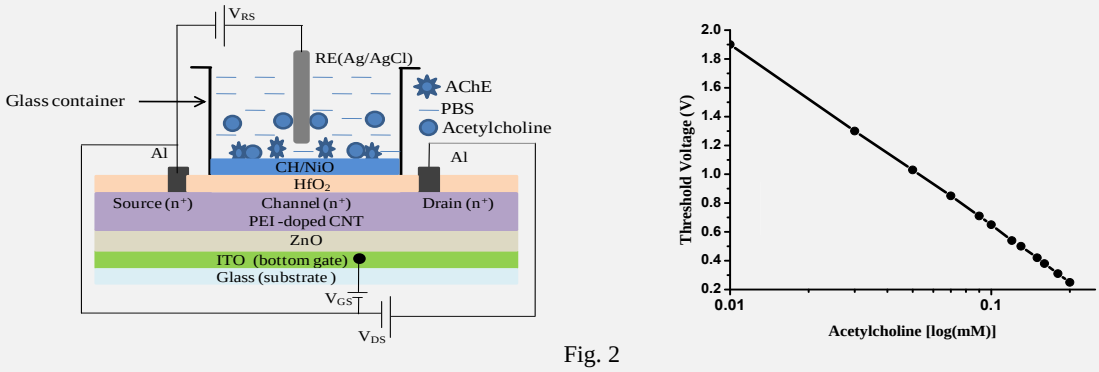

Fig. 2

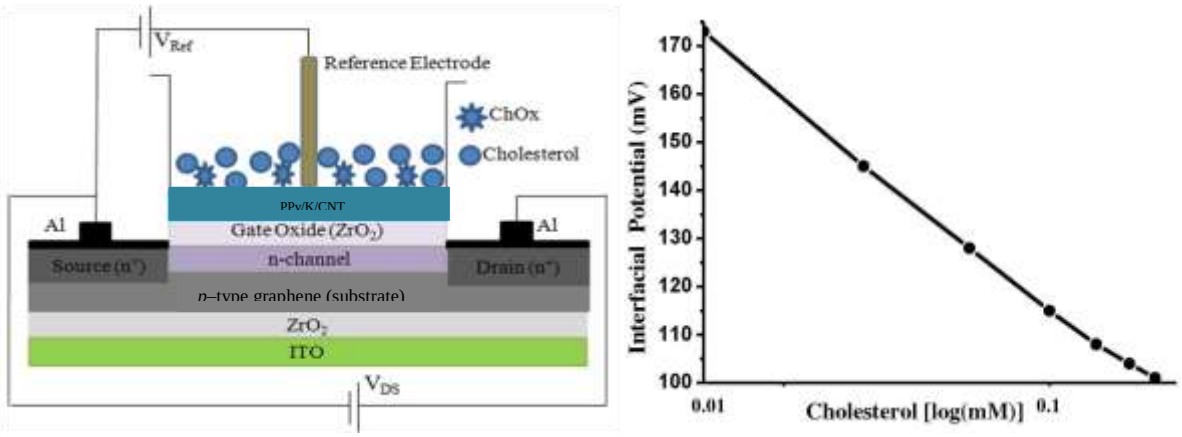

Fig. 3