Chapter 6

Fabrication of nonenzymatic cholesterol sensor using platinum mesoparticles modified disposable screen printed carbon electrodes
6. Fabrication of nonenzymatic cholesterol sensor using platinum mesoparticles modified disposable screen printed carbon electrodes

The accumulation of cholesterol in body can cause serious coronary heart diseases and atherosclerosis. This necessitates the measurement of cholesterol in the body. The major methodologies adopted for cholesterol sensing is discussed in section 1.5. Most of them are based on enzymatic reactions and only a few reports are on the nonenzymatic detection of cholesterol. Commercially available cholesterol sensing strips are of high cost (nearly 4.0 USD) and are not common in market as glucose test strips (nearly 0.3 USD) (web knowledge). Thus a low cost cholesterol test strips find very good market potential.

The present work is envisaged to develop a non-enzymatic disposable cholesterol sensor strip using platinum mesoparticles decorated screen printed electrodes. The Pt mesoparticles were electrodeposited on the screen printed electrode. In order to enhance the selectivity nafton was cast on the electrode. The fabricated sensor strip was tested with standard cholesterol solution and cholesterol present in egg yolk and skin.

6.1 Experimental
6.1.1 Preparation of cholesterol solution

Cholesterol stock solution of 200 mg dL⁻¹ (5.17 mM) was prepared by dissolving weighed amount of cholesterol in Triton X-100 and heating at 85 °C to get a clear solution. This was diluted with PBS (0.1 M, pH=7.4), to bring down the Triton X-100 concentration to 3% (v/v). The solution was heated with continuous stirring for 30 minutes and on slow cooling to room temperature it becomes clear. This stock solution was diluted and used for analysis. The solution is stored under refrigeration (4 °C) when not in use.

6.1.2 Fabrication of disposable cholesterol sensor (Nf/Pt/SPCE)

Figure 6.1 depicts the fabrication of the disposable cholesterol sensor. Screen printed electrodes (SPCE) were fabricated indigenously by the procedure explained in
section 2.3.2. Platinum mesoparticles (PtMP) were electrodeposited on the working electrode from a 5 mM chloroplatinic acid solution at -0.4 V (vs Ag/AgCl (pseudo)). The deposition time was optimised to get better electrochemical activity to cholesterol. The electrode was then washed with distilled water for removing the loosely adhered particles and dried in air. 5 µL Nafion 117 solution (1% volume in ethyl alcohol) was dropped and dried in air. Thus fabricated electrode was named as Nf/PtMP/SPE and used for the sensing of cholesterol. The response obtained was compared with those obtained on platinum modified SPCE without nafion coating (abbreviated as PtMP/SPCE).

![Fabrication of disposable cholesterol sensor.](image)

**Figure 6.1. Fabrication of disposable cholesterol sensor.**

### 6.1.3 Methodology for detection of cholesterol

Cyclic voltammetric (CV) analysis was performed using the sensor with different concentrations of cholesterol in PBS at 0.1 V s⁻¹ scan rate between potential limits of 0 and 0.8 V. Differential pulse voltammograms (DPV) were performed between 0 and 0.8 V in 0.1 M PBS with and without cholesterol. The DPV pulse amplitude was 0.05 V, pulse width 0.06 s and a pulse period of 0.5 s. Steady state current response was measured at the predetermined oxidation potential of cholesterol from CV. The sensor Nf/PtMP/SPCE was dipped in the respective cholesterol solutions for 2 minutes to equilibrate before it was subjected for CV, DPV and steady state amperometric measurements. The amperometric response at 3 s was monitored with different concentrations of cholesterol. In the case of PtMP/SPCE the electrodes were washed with absolute alcohol followed by water before each analysis. These electrodes were used repeatedly for testing.

### 6.1.4 Real sample analysis

The sensor fabricated was tested for the following real samples,
Egg yolk cholesterol: Cholesterol from egg yolk was extracted by the method described in section 2.3.5. The residue after the extraction was dissolved in Triton X-100 and diluted with buffer. The solution was spiked with standard cholesterol solution and the response current monitored through DPV.

Skin cholesterol: Skin tissue cholesterol (Skin Tc) was extracted by the simple procedure described in section 2.3.6. Dissolved the solid obtained in hot Triton X-100 and diluted with PBS. 2 mL of this solution was spiked with 2 mL standard cholesterol solution and analyzed using DPV.

6.2 Results and Discussion

6.2.1 Electrodeposition of PtMP on SPCE

![Graph](image)

**Figure 6.2.** CV recorded on SPCE in 5 mM chloroplatinic acid solution at 0.1 V s⁻¹.

Figure 6.2 shows the CV recorded on SPCE in 5 mM H₂PtCl₆ solution at 0.1 V s⁻¹. CV analysis in 5 mM chloroplatinic acid indicates that the reduction of Pt starts at -0.2 V. Deposition was carried out with a range of potential from -0.2 V and found that above -0.4 V hydrogen evolution takes place and below -0.4 V the deposition rate is less. Hence, the platinum deposition was carried out at -0.4 V. Deposition time was varied to get different amounts of Pt on the surface.
6.2.2 Morphology of modified electrodes

Figure 6.3. FESEM images of (A) SPCE, (B) PtMP/SPCE, (C) Nf/PtMP/SPCE electrodes and (D) the EDS spectrum of PtMP/SPCE.

Figure 6.3. shown the FESEM images of SPCE, PtMP/SPCE, Nf/PtMP/SPCE electrodes. It can be seen that the SPE surface is highly rough and porous which increases the effective surface area (Fig. 6.3 A). The PtMP/SPCE surface shows uniform sized spherical Pt mesoparticles of about 500 nm are evenly distributed (Fig. 6.3 B). The presence of platinum on the electrode was confirmed by EDS analysis (Fig. 6.3 D). Nafion formed a thin layer over the PtMP/SPCE as shown in Fig. 6.3 C. Nafion film provides extra adhesion to the platinum particles on SPCE.

The 3D AFM image in Fig.6.4 A shows that the unmodified SPCE surface is rough and is highly nonuniform. Figure 6.4 B shows the uniform platinum deposit on the PtMP/SPCE surface. The nafion coating in Nf/PtMP/SPCE covers the PtMP on the surface and the surface roughness decreased as shown in Fig. 6.4 C. These results are well in agreement with the FESEM images.
6.2.3 Electrochemical characterization of the modified electrodes

6.2.3.1 In redox mediator potassium ferricyanide

In order to understand the electrochemical property of the modified electrodes CVs and EIS were recorded in 1.5 M KCl solution containing 5 mM K₃[Fe(CN)₆]. The unmodified SPCE shows quazi reversible [Fe(CN)₆]⁴⁻/[Fe(CN)₆]³⁻ cyclic voltammogram (Fig. 6.5 A). The peak potential difference is 474 mV and the peaks are not well defined. This large difference in peak potentials was due to the organic solvents and binders used for the dispersion of the printing ink. Similar results have been reported earlier on the redox of ferricyanide on SPCE [337]. On the PtMP/SPCE well defined redox peaks were obtained with peak potential difference of 64 mV and the ratio of anodic and cathodic peak currents was close to one (Fig. 6.5 B). This shows the excellent reversibility of ferricyanide reaction on Pt/SPCE [24]. The increase in charging current may be due to the increased effective surface area provided by the platinum mesoparticles. On the Ni/PtMP/SPCE the redox peaks were

Figure 6.4 AFM images of the SPCE (A), PtMP/SPCE (B) and Ni/PtMP/SPCE (C)
not defined and show a decrease in current response (Fig. 6.5 C). This is due to the increased charge transfer resistance offered by the nafion film for anions.

![Cyclic Voltammograms](image)

**Figure 6.5.** Cyclic voltammograms recorded on (A) SPCE, (B) PtMP/SPCE and (C) Ni/PtMP/SPCE in 1.5 M KCl containing 5 mM potassium ferricyanide.

The results of ac impedance measurements on the modified SPCE in ferricyanide solution are shown in Fig 6.6. The charge transfer resistance of SPCE decreased considerably after the deposition of PtMP and it again increased after casting with nafion. The Randle’s equivalent circuit having the combination of solution resistance ($R_s$), charge transfer resistance ($R_{ct}$), constant phase element (Q or CPE) and mass transfer resistance (W) best fit for the experimental impedance spectrum is shown as inset of Fig. 6.6. The CPE elements show the frequency dispersion due to the formation of complex double layer.
Table 6.1 depicts the component values for the best fit equivalent circuit derived for the modified electrodes. The solution resistance ($R_s$) was more or less constant on the modified electrode. The values in the Table point out that the charge transfer impedance ($R_{ct}$) decreases 100 times after the incorporation of platinum mesoparticles on SPCE. Similar observations were found in cyclic voltammetric experiments also. The complex double layer capacitance (CPE) increased 100 times.
on PtMP/SPCE compared to the SPCE. Also the constant ‘α’ decreases after the incorporation of PtMP shows that the increased nonuniformity on the surface. This also implies that there is an increase in catalytic surface area on mesoparticles decorated surface. The mass transfer resistance shows a decrease after the PtMP incorporation. For the Nf/PtMP/SPCE the $R_{ct}$ values increased to $3.3 \times 10^4$, which shows a decreased charge transfer, in support for the CV shown in Fig. 6.5. The slight decrease in CPE and the increase in ‘α’ suggest better uniformity or planarity on the electrode after the nafion coating. This is in support with the AFM results (Fig. 6.4). The Warburg impedance increases on the Nf/PtMP/SPCE indicates that impedance increases for diffusion of ions to the electrode after coating the ionically conducting polymer.

<table>
<thead>
<tr>
<th>Table 6.1</th>
<th>Best fit equivalent circuit values correspond to the impedance plots recorded in ferricyanide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrode</td>
<td>$R_s$ (Ω)</td>
</tr>
<tr>
<td>SPCE</td>
<td>25.92</td>
</tr>
<tr>
<td>PtMP/SPCE</td>
<td>25.8</td>
</tr>
<tr>
<td>Nf/PtMP/SPCE</td>
<td>28.33</td>
</tr>
</tbody>
</table>

6.2.3.2 In phosphate buffer saline

Figure 6.7 presents the CVs recorded in PBS (0.1 M, pH 7.4) at a scan rate of 0.1 V s$^{-1}$. CV recorded on SPCE does not show a faradaic peak in PBS. After the incorporation of PtMP, rise in faradaic current at +0.45 V is observed, this could be due to the formation of oxides or hydroxides of platinum. Also there is a huge rise in capacitive current that indicates the increase in surface area of the electrode after the mesoparticles formation. On Nf/PtMP/SPCE the current response is less compared to PtMP/SPCE due to the organic film on the surface.
Figure 6.7. CVs recorded on the modified SPCE 0.1 M PBS (pH=7.4) at a scan rate of 0.1 V s$^{-1}$

This change in current response due to the change in charge transfer resistance on the electrode is given by the EIS plots (Fig. 6.8). Equivalent circuit for the system is designed with CPE component and is given as the inset in Fig. 6.8. The values for the components are tabulated in Table 6.2.

It is evident from Table 6.2 that the $R_{ct}$ values for the modified electrodes are least for PtMP/SPCE and indicates that faradaic reactions occur easily on this surface. The capacitance (CPE) increased $10^3$ times after the PtMP incorporation on SPCE points out the increase in surface area after mesoparticles deposition. All these results establish that PtMP/SPCE electrode is a better electrocatalytic material.
Figure 6.8 EIS plots recorded on the modified electrodes in 0.1 M PBS at 5 mV ac amplitude. Randles equivalent circuit designed (inset). OCP values for SPCE, PtMP/SPCE and Nf/PtMP/SPCE are 0.35, 0.31 and 0.32 V respectively.

Table 6.2 Best fit equivalent circuit values correspond to the impedance plots recorded in PBS.

<table>
<thead>
<tr>
<th>Electrode</th>
<th>$R_s$ ($\Omega$)</th>
<th>$R_{ct}$ ($\Omega$)</th>
<th>$Q$ or CPE ($S,s^\alpha$)</th>
<th>$W$ ($S\cdot s^{0.5}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPCE</td>
<td>53.03</td>
<td>$2.48 \times 10^5$</td>
<td>$3.92 \times 10^{-7}$</td>
<td>$5.41 \times 10^{-6}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$\alpha = 0.9213$</td>
<td></td>
</tr>
<tr>
<td>PtMP/SPCE</td>
<td>53.56</td>
<td>$8.21 \times 10^5$</td>
<td>$2.06 \times 10^{-4}$</td>
<td>$1.18 \times 10^{-3}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$\alpha = 0.8348$</td>
<td></td>
</tr>
<tr>
<td>Nf/PtMP/SPCE</td>
<td>51.15</td>
<td>$2.08 \times 10^5$</td>
<td>$2.02 \times 10^{-5}$</td>
<td>$2.66 \times 10^{-5}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$\alpha = 0.7864$</td>
<td></td>
</tr>
</tbody>
</table>
6.2.4 Detection of Cholesterol

6.2.4.1 Electrooxidation of cholesterol on PtMP/SPCE

Figure 6.9. CV recorded on PtMP/SPE in 0.1 M PBS containing different concentrations of cholesterol at 0.1 V s⁻¹ scan rate.

Cholesterol oxidation was studied on the PtMP/SPCE using CV in 0.1 M PBS (pH 7.4) with different concentrations of cholesterol and results are shown in Fig. 6.9. PtMP/SPCE electrode exhibits an increase in current at +0.4 V in PBS in the absence of cholesterol. This could be due to the formation of oxides or hydroxides of platinum in PBS. After the addition of cholesterol, a rise in oxidation current is observed at +0.4 V corresponding to the oxidation of cholesterol [388]. Similar observations were made for the oxidation of cholesterol on platinum modified CNT layers [316]. Also as in the benzyl alcohol oxidation on platinum, cholesterol oxidation may occur via the adsorption of cholesterol on platinum. This is followed by the formation of platinum alcoholate and then oxidized to cholestenone [389]. This mechanism can be schematically represented below,

![Proposed mechanism of cholesterol oxidation on PtMP/SPCE](image)

Figure 6.10. Proposed mechanism of cholesterol oxidation on PtMP/SPCE
The peak obtained was not sharp on PtMP modified electrode indicating the slow oxidation kinetics. Repeated cycles in same cholesterol solution lead to inconsistent results because of the adsorption of oxidation products on the electrode surface. Similar studies on poisoning of platinum surface with various reaction products were reported [33]. Washing the electrode with water and alcohol removes these adsorbed products and the CVs were reproducible. The oxidation current increases linearly with concentration up to 3 mM and after that the response remains the same.

![Figure 6.11](image)

**Figure 6.11.** (A) Effect of scan rate on the cholesterol oxidation current in 0.1 M PBS and (B) plot of response current with scan rate.

Effect of scan rate on the electrooxidation of cholesterol on the sensor was studied from 0.02 V s\(^{-1}\) to 0.14 V s\(^{-1}\) (Fig. 6.11). The response current increases linearly with scan rate indicating that the cholesterol oxidation on the modified electrode follows surface confined process [24].

In order to optimize the amount of Pt to be deposited on SPCE for the best response to cholesterol, different electrodes were prepared by varying the time of deposition at constant potential of 0.4 V. The amount of deposited Pt was calculated using Faraday’s law by taking the platinum deposition efficiency as 100%. Thus fabricated electrodes were tested with 1 mM cholesterol and the response obtained was compared in Fig. 6.12. It was found that the electrode fabricated by depositing Pt for 90 s (corresponds to 2.847 µg cm\(^{-2}\)) has the higher response current towards cholesterol and the results are highly reproducible.
The interferences from glucose, ascorbic acid, urea and uric acid were studied using voltammetry and are shown in Fig 6.13. It was found that glucose and ascorbic acid show positive interference on PtMP/SPCE sensor. Urea and uric acid did not give considerable response. The concentrations of interfering molecules chosen for analysis were slightly above the physiological levels. Thus the results indicate that the PtMP/SPCE can be used as a nonenzymatic cholesterol sensor, but the interferences of different biomolecules have to be avoided.

![Figure 6.13. CVs recorded in 0.1 M PBS on PtMP/SPCE with cholesterol and other interfering species at 0.1 V s⁻¹.](image)

**Figure 6.12.** Comparison of sensitivities of the sensors fabricated with different amount of Pt deposited on SPCE surface
6.2.4.2 Detection of cholesterol on Nf/PtMP/SPCE

Fig. 6.14 shows the CV response obtained on Nf/PtMP/SPE electrode with different concentrations of cholesterol. It is evident from the CV that there is an increase in oxidation current at +0.2 to +0.6 V after the addition of cholesterol. This increase in current is due to the electrooxidation of cholesterol to cholestenone. Similar observation was made on Pt modified CNT for the fabrication of cholesterol sensor [316]. For comparison background current also was measured in PBS solution containing the surfactant Triton X-100 equivalent to that in cholesterol solutions tested. But there was no faradaic current response observed. This established that the increased current is due to the electrochemical oxidation of cholesterol. The broad peak indicates slow oxidation kinetics on the Nf/PtMP/SPCE electrode. These nafion modified electrodes are used for single time measurement since the oxidation products poison the sensor surface.

![Figure 6.14. CVs recorded on Nf/PtMP/SPCE in 0.1 M PBS containing different concentrations (0, 1, 2, 3 mM) of cholesterol at a scan rate of 0.1 V s⁻¹.](image)

Voltammograms on Nf/PtMP/SPCE in PBS with cholesterol in presence of interfering molecules in Fig. 6.15 show that the response current for AA, Glu, UA, urea are negligible when compared with that of cholesterol. Thus nafion inhibits the oxidation of other biomolecules on the sensor and increases the selectivity of the sensor developed. The response obtained on the PtMP/SPCE and Nf/PtMP/SPCE for
the interfering molecules was compared in Table 6.3, keeping the response for 2.5 mM cholesterol as 100% response current.

![Figure 6.15](image-url)

**Figure 6.15.** CVs recorded on Nf/PtMP/SPCE with cholesterol in PBS at a scan rate of 0.1 V s\(^{-1}\) with interfering molecules.

<table>
<thead>
<tr>
<th>Biomolecule</th>
<th>Tested concentration</th>
<th>% response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PtMP/SPE</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>2.5 mM</td>
<td>100</td>
</tr>
<tr>
<td>Glucose</td>
<td>6 mM</td>
<td>14.85</td>
</tr>
<tr>
<td>Ascorbic acid</td>
<td>125 µM</td>
<td>49.03</td>
</tr>
<tr>
<td>Uric acid</td>
<td>125 µM</td>
<td>0.2</td>
</tr>
<tr>
<td>Urea</td>
<td>200 µM</td>
<td>2.55</td>
</tr>
</tbody>
</table>

6.2.4.3 Voltammetric estimation of cholesterol

The DPV response for the Nf/PtMP/SPCE sensor to various cholesterol concentrations was monitored and presented in Fig. 6.16. It is observed that the DPV response increases with increase in concentrations of cholesterol. DPV was chosen for the analysis since it is more sensitive compared to CV for the electrochemical studies and could detect analytes at very low concentrations [390].
Figure 6.16. DPV recorded on Nf/PtMP/SPCE sensor with different concentrations of cholesterol (A), calibration plot with cholesterol concentration with response current (B).

The calibration curves in Fig. 6.15 B, show that the sensor response is linear up to 3 mM (116 mg dL\(^{-1}\)). The sensor shows a sensitivity of 197.7 µA mM\(^{-1}\) cm\(^{-2}\) with linear fit equation \(j_p (mA cm^{-2}) = 0.0236 + 0.1977 C (mM)\) with a standard deviation 0.0229. The regression coefficient of 0.9962 for six values indicates the response is highly linear. The lower detection limit is calculated to be 10 µM (S/N = 3).

6.2.4.4 Amperometric determination of cholesterol

Figure 6.17. (A) Steady state current response measured for the Nf/PtMP/SPCE sensor in 0.1 M PBS with different concentrations of cholesterol at +0.6 V and (B) the calibration plot.

Steady state current response for the sensor was monitored at +0.6 V by varying cholesterol concentrations ranging from 0 mM to 5.0 mM in 0.1 M PBS. Prior to the analysis Nf/PtMP/SPE sensor dipped in the respective cholesterol solutions for
2 minutes and the current response was monitored. The response obtained is shown in Fig. 6.17 A.

Steady state response current recorded at +0.6 V illustrates the response current increases with cholesterol concentration up to 3 mM \((j_p \text{ (mA cm}^{-2}) = 0.04746 + 0.0813 C \text{ (mM)}, \ r= 0.98622, \sigma= 0.0152, \ N= 8)\). The calibration curve with response current and the concentration of cholesterol is presented in Fig. 6.17 B.

6.2.4.5 Reproducibility and repeatability

Six Nf/PtMP/SPCE electrodes were fabricated and tested with 1 mM cholesterol, and found that the response current is stable with only a variation of 3% among the strips. This establishes the high reproducibility of the sensor fabrication process. The variation of DPV response current is depicted in Fig. 6.18.

![Graph showing variation of DPV response current for six Nf/PtMP/SPCE sensors](image)

**Figure 6.18.** Variation of DPV response current for six Nf/PtMP/SPCE sensors

6.2.4.6 Estimation of cholesterol levels in real samples

**Egg yolk cholesterol:** Cholesterol from egg yolk was extracted by the procedure mentioned in the experimental section. The DPV response obtained for the sensor is depicted in Fig. 6.13 A. Comparison of the response obtained and the calibration graph yielded a cholesterol concentration of 0.96 mM equivalent to 1.14 g in 100 g of yolk, which is slightly lower but comparable with standard values available for chicken egg (1.24 g in 100 g of yolk). This indicates a possibility for the applicability of the sensor for cholesterol determination in food samples.

**Skin cholesterol:** Preliminary investigations were carried out to test the applicability of the sensor to the amount of cholesterol from skin epidermis. The noninvasive
SkinTc determination was performed using the cholesterol extracted from palm of different volunteers. The response current obtained from DPV was used for the quantification of cholesterol by spiking (Fig. 6.19 B). From the response obtained the skin cholesterol level is calculated to be 85.27 mg dL\(^{-1}\) which is in accordance with that reported values of 56-110 mg dL\(^{-1}\).

![Graph showing DPV recorded with cholesterol from egg yolk and DPV recorded on the sensor electrode for the skin cholesterol samples.]

**Figure 6.19.** (A) DPV recorded with cholesterol from egg yolk and (B) DPV recorded on the sensor electrode for the skin cholesterol samples.

### 6.2.4.7 Comparison of sensor response with reported sensors

#### Table 6.4. Comparison of sensor response with reported sensors

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Method</th>
<th>Sensitivity (μA mM(^{-1}) cm(^{-2}))</th>
<th>Linear range (mM)</th>
<th>Detection limit (µM)</th>
<th>Negligible interference from</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cu rod / Cu(_{2})SNRs</td>
<td>Nonenzymatic</td>
<td>62.5</td>
<td>0.01-6.8</td>
<td>0.1</td>
<td>AA, UA, DA</td>
<td>[319]</td>
</tr>
<tr>
<td>MWCNT@MIP</td>
<td>MIP</td>
<td></td>
<td>10–300 nM</td>
<td>0.001</td>
<td>Not given</td>
<td>[307]</td>
</tr>
<tr>
<td>Pt/PEDOP/ChOx</td>
<td>Enzymatic</td>
<td>10</td>
<td>3.4</td>
<td>400</td>
<td>Not given</td>
<td>[391]</td>
</tr>
<tr>
<td>ITO/CHIT-SiO(_{2})/MWCNT/ChOx</td>
<td>Enzymatic</td>
<td>13</td>
<td>13</td>
<td>20</td>
<td>AA, UA, Glu</td>
<td>[299]</td>
</tr>
<tr>
<td>Pt-CNT-CHIT/ChOx</td>
<td>Enzymatic</td>
<td>0.01-3</td>
<td></td>
<td></td>
<td>AA, DA, AP</td>
<td>[294]</td>
</tr>
<tr>
<td>Grp-β-CD</td>
<td>Nonenzymatic</td>
<td>0.001-0.1</td>
<td>11</td>
<td>11</td>
<td>different molecules</td>
<td>[317]</td>
</tr>
<tr>
<td>AuNP/PDDA/CNT</td>
<td>Enzymatic</td>
<td>31.58</td>
<td>0.02-1.2</td>
<td>4</td>
<td>UA, AA</td>
<td>[289]</td>
</tr>
<tr>
<td>Ni/PtMP/SPCE</td>
<td>Nonenzymatic</td>
<td>197.7</td>
<td>Up to 3 mM</td>
<td>10</td>
<td>Glu, AA, UA, urea</td>
<td>This work</td>
</tr>
</tbody>
</table>
Comparison of the Nf/PtMP/SPCE with other recently reported cholesterol sensors show that the sensor has very good sensitivity. The detection limit, linear range and the anti-interference property are competent with other sensors. Moreover most of the other works are on conventional electrodes, but the sensor developed in this work is on a disposable screen printed electrodes. This shows the possibility for commercial viability of the sensor for cholesterol determination.

6.3 Conclusion

Highly sensitive and selective sensor was fabricated for the nonenzymatic amperometric detection of cholesterol. The sensor fabricated using platinum mesoparticles decorated screen printed electrodes were thoroughly analysed for its cholesterol sensing properties. The sensor showed a sensitivity of 197.7 µA mM⁻¹cm² and a lower detection limit of 10 µM and it was tested in chicken egg yolk and skin epidermis for cholesterol estimation. The disposable nonenzymatic sensor is well suited for the commercial production because of the simple and easy operation procedure.