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**Faculty of Women's for Arts**  
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**Cairo- Egypt**

***New Designs for Chemical Ion Sensors and Their Use in  
Environmental and Industrial Applications***

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**❖ Published papers extracted from the master thesis:**

**1. Single-Piece All-Solid-State Potential Ion Selective Electrodes Integrated with Molecularly Imprinted Polymers (MIPs) for Neutral 2,4-Dichlorophenol Assessment.**

**2. Modified potentiometric screen-printed electrodes based on imprinting character for bile acids determination: Application to Bovine human serum quantification**

Article

# Single-Piece All-Solid-State Potential Ion-Selective Electrodes Integrated with Molecularly Imprinted Polymers (MIPs) for Neutral 2,4-Dichlorophenol Assessment

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**Abstract:** A novel single-piece all-solid-state ion-selective electrode (SC/ISE) based on carbon-screen printed is introduced. Polyaniline (PANI) is dissolved in a membrane cocktail that contains the same components used for making a conventional ion-selective polyvinyl chloride (PVC) matrix membrane. The membrane, having the PANI, is directly drop-casted on a carbon substrate (screen-printed-carbon electrode). PANI was added to act as an intermediary between the substrate and the membrane for the charge transfer process. Under non-equilibrium sensing mechanism, the sensors revealed high sensitivity towards 2,4-dichlorophenol (DCP) over the linearity range 0.47 to 13  $\mu$ M and a detection limit 0.13  $\mu$ M. The selectivity was measured by the modified separate solution method (MSSM) and showed good selectivity towards 2,4-DCP over the most commonly studied ions. All measurements were done in 30 mM Tris buffer solution at a pH 5.0. Using constant-current chronopotentiometry, the potential drift for the proposed electrodes was checked. Improvement in the potential stability of the SPE was observed after the addition of PANI in the sensing membrane as compared to the corresponding coated-wire electrode (membrane without PANI). The applicability of the sensor has been checked by measuring 2,4-DCP in different water samples and the results were compared with the standard HPLC method.

**Keywords:** solid-contact ISEs; molecularly imprinted polymers (MIPs); chlorophenols; 2,4-dichlorophenol; neutral response mechanism.

## 1. Introduction

Chlorophenols, a class of organic pollutants, have recently drawn considerable attention. These organochlorine compounds have been classified as persistent organic pollutants (POPs) as well as endocrine disrupting compounds (EDCs) [1–3]. Due to their constancy in aquatic environments, they can be released to either surface or ground waters as good as bottom sediments. 2,4-DCP has been widely applied in the yield of various herbicides, pesticides, preservatives, and plant growth regulators [4]. Most of the chlorinated phenols can be found and are accumulated in the human body through the food cycle. They can cause felled effects such as faintness, itch, anemia, and cancer risk at extremely low concentration levels [3,5]. After inhalation of 2,4-DCP, the respiratory tract is irritated and this is harmful to the liver, kidneys and organs forming blood [6–9]. Long exposure to 2,4-DCP can

## Article

# Modified Potentiometric Screen-Printed Electrodes Based on Imprinting Character for Sodium Deoxycholate Determination

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**Abstract:** Potentiometric sensors have a great influence on the determination of most various compounds in their matrices. Therefore, efficient and new sensors were introduced to measure sodium Deoxycholate (NaDC) as a bile acid salt. These sensors are based on NaDC imprinted polymer (MIP) as sensory element. The MIP beads were synthesized using thermal polymerization pathway, in which acrylamide (AAM), ethylene glycol dimethacrylate (EGDMA), NaDC, and benzoyl peroxide (BPO) were used as the functional monomer, cross-linker, template, and initiator, respectively. The proposed sensors were fabricated using a coated screen-printed platform and the sensing membrane was modified by single-walled carbon nanotubes (SWCNTs) as an ion-to-electron transducer. The sensors exhibited high sensitivity that reached  $4.7 \times 10^{-4}$  M of near-Nernstian slope ( $-60.1 \pm 0.9$  mV/decade,  $r^2 = 0.999$  ( $n = 5$ )). In addition, the sensors revealed high selectivity, long lifetime, high potential stability, and conductivity that ensure reproducible and accurate results over a long time. MIP characterization was performed using Fourier Transform-Infrared (FT-IR) and a scanning electron microscope (SEM). Regarding the interaction of NaDC with serum albumin (SA), albumin is determined in human serum samples as human serum albumin (HSA), which was collected from different volunteers of different ages and gender.

**Keywords:** sodium deoxycholate (NaDC); molecular imprinted polymer (MIP); screen-printed ion selective electrodes; single-walled carbon nanotubes (SWCNTs); human serum albumin (HSA)

## 1. Introduction

Sodium deoxycholate (NaDC) compound (Figure 1) is considered as one of the bile acid salts that biosynthesized in the liver of the human body from cholesterol moiety. These bile salts have a great biological role as an emulsifiers for different biological compounds in the body such as fat-soluble vitamins in the intestine, bilirubin, cholesterol, and lecithin [1,2]. NaDC has the steroidal skeleton with four rings containing hydroxyl groups and terminating in a carboxylic acid group. It is a water-soluble compound that has a good acceptability for pharmaceutical products and enhances

## Contents

	<i>Page</i>
<i>List of Contents.....</i>	<i>i</i>
<i>List of Figures.....</i>	<i>v</i>
<i>List of Tables.....</i>	<i>ix</i>
<i>List of Abbreviations.....</i>	<i>x</i>
<i>Summary.....</i>	<i>xii</i>

## *Chapter (I)*

### *General introduction*

<b>1.1.Potentiometric sensors.....</b>	<b>1</b>
<b>1.1.1.Recognition layer .....</b>	<b>2</b>
<b>1.1.2.Ion -Selective Membranes(ISM).....</b>	<b>3</b>
<b>1.1.3.Components of ISE Membranes.....</b>	<b>3</b>
<b>1.1.3.1. Polymeric Matrix.....</b>	<b>3</b>
<b>1.1.3.2. Lipophilic Salts.....</b>	<b>5</b>
<b>1.1.4.Working Mechanism of Ion Selective Electrode.....</b>	<b>6</b>
<b>1.1.5.Sensitivity.....</b>	<b>8</b>
<b>1.1.6.Selectivity.....</b>	<b>8</b>
<b>1.1.7.Limit of Detection.....</b>	<b>10</b>
<b>1.1.8. Response Time.....</b>	<b>11</b>
<b>1.2.Solid Contact Ion Selective Electrodes.....</b>	<b>12</b>
<b>1.2.1. General.....</b>	<b>12</b>

<i>1.2.2. Types of Solid Contact Ion-Selective Electrode.....</i>	<i>13</i>
<i>1.2.2.1. Coated Wire Ion-Selective Electrode.....</i>	<i>13</i>
<i>1.2.2.2. Conducting Polymers as Transducer Layer.....</i>	<i>13</i>
<i>1.2.2.2.1. Polyaniline.....</i>	<i>15</i>
<i>1.2.2.3. Carbon/ Nanoparticles as Transducer Layer.....</i>	<i>15</i>
<i>1.2.2.3.1. Nanostructured Carbon Based Materials.....</i>	<i>17</i>
<i>1.2.2.3.1.1. Carbon Nanotubes (CNTs).....</i>	<i>17</i>
<b>1.3. Challenges in Potentiometric Solid Contact Ion Selective Electrodes.....</b>	<b>20</b>
<i>1.3.1. Challenges of Plasticized PVC-Based Ion-Selective Membranes.....</i>	<i>20</i>
<i>1.3.1.1. Leaching of Membrane Components.....</i>	<i>20</i>
<i>1.3.1.2. Water Uptake of Ion Selective Membranes.....</i>	<i>21</i>
<i>1.3.2. Challenges Connected to Electrically Conducting Polymers as Solid Contact.....</i>	<i>23</i>
<i>1.3.2.1. O<sub>2</sub> and CO<sub>2</sub> Sensitivity.....</i>	<i>23</i>
<i>1.3.2.2. Light Sensitivity.....</i>	<i>24</i>
<b>1.4. Reproducibility and Stability of Solid-Contact Ion-Selective Electrodes.....</b>	<b>25</b>
<i>1.4.1. Piece-to-Piece Reproducibility.....</i>	<i>25</i>
<i>1.4.2. Potential Stability .....</i>	<i>25</i>
<b>References .....</b>	<b>26</b>



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**Chapter (II)*****Single-Piece All-Solid-State Potential Ion Selective  
Electrodes Integrated with Molecularly Imprinted Polymers  
(MIPs) for Neutral  
2,4-Dichlorophenol Assessment.***

<b>2.1. Introduction .....</b>	<b>40</b>
<b>2.2. Materials and Methods .....</b>	<b>43</b>
<b>2.2.1. Materials and Instruments .....</b>	<b>43</b>
<b>2.2.2. Synthesis of MIPs .....</b>	<b>44</b>
<b>2.2.3. Design and Fabrication of the Screen-Printed Electrodes (SPEs).....</b>	<b>44</b>
<b>2.2.4. Potentiometric Measurements.....</b>	<b>45</b>
<b>2.3. Results and Discussion.....</b>	<b>46</b>
<b>2.3.1. Characterization of the MIP Particles .....</b>	<b>46</b>
<b>2.3.2. Sensor Analytical Features.....</b>	<b>53</b>
<b>2.3.3. Selectivity.....</b>	<b>56</b>
<b>2.3.4. Constant-current Chronopotentiometry.....</b>	<b>58</b>
<b>2.3.5. Electrochemical Impedances and Chronopotentiometry Measurements.....</b>	<b>59</b>
<b>2.3.6. Water Layer Test.....</b>	<b>62</b>
<b>2.3.7. Analytical Applications.....</b>	<b>63</b>
<b>2.4. Conclusion.....</b>	<b>64</b>
<b>References.....</b>	<b>65</b>

---

**Chapter (III)*****Modified Potentiometric Screen-Printed Electrodes  
Based on Imprinting Character for Sodium  
Deoxycholate Determination***

<b>3.1. Introduction .....</b>	<b>72</b>
<b>3.2. Materials and Methods .....</b>	<b>74</b>
<b>3.2.1. Apparatus .....</b>	<b>74</b>
<b>3.2.2. Reagents and Materials .....</b>	<b>75</b>
<b>3.2.3. Molecular Imprinted (MIP) and Non-Imprinted Polymers             (NIP) Synthesis.....</b>	<b>67</b>
<b>3.2.4. Membranes and Electrode Construction .....</b>	<b>76</b>
<b>3.2.5. Determination of Bile Acids in Pharmaceutical         Preparations.....</b>	<b>77</b>
<b>3.2.6. Potentiometric Assay of Bovine Serum Albumin (BSA).....</b>	<b>77</b>
<b>3.3. Results and discussions.....</b>	<b>78</b>
<b>3.3.1. Characterization of MIP particle.....</b>	<b>78</b>
<b>3.3.2. Membrane optimization.....</b>	<b>81</b>
<b>3.3.3. Potential stability.....</b>	<b>87</b>
<b>3.3.4. Electrochemical Impedance Spectrometry (EIS) .....</b>	<b>88</b>
<b>3.3.5. Selectivity Studies.....</b>	<b>90</b>
<b>3.3.6. Analytical Applications.....</b>	<b>92</b>
<b>3.4. Conclusion.....</b>	<b>97</b>
<b>References.....</b>	<b>98</b>

**List of Figures:**

<b><i>Chapter (I)</i></b>	<b><i>page</i></b>
Figure (1.1)	A potentiometric cell is composed by a reference electrode and a working ion-selective electrode connected to a high impedance potentiometer. <b>2</b>
Figure (1.2)	Figure illustrating the separate solution method (SSM). <b>9</b>
Figure (1.3)	Main analytical performance parameters for an ISE. <b>11</b>
Figure (1.4)	Working principle of solid-contact ISEs based on an oxidized (p-doped) conducting polymer as ion-to-electron transducer. EC: electronic conductor, CP: conducting polymer, ISM: ion-selective membrane, S: solution, e: electron, L: ion recognition site. Primary ions are circled and counter ions are squared. <b>14</b>
Figure (1.5)	PANI Green emeraldine salt. <b>15</b>
Figure (1.6)	Schematic representation of all-solid-state ISE based on a high surface area SC exhibiting a high double layer capacitance. <b>16</b>
Figure (1.7)	Graphical representations of ideal sheet, SWCNT and MWCNT. <b>18</b>

Figure (1.8)	Cell unit for a single-walled carbon nanotube (4,2).	<b>19</b>
Figure (1.9)	Chemical structures of (10,10) armchair, (0,10) zig-zag and (7,10) chiral SWCNTs, SWCNTs and representation of metallic/semi-metallic distribution of SWCNTs according to the Hamada vector.	<b>19</b>
Figure (1.10)	Schematic illustration of the potentiometric aqueous layer test. The solid and dashed lines represent SC-ISEs and coated-wire electrode, respectively.	<b>23</b>
<b><i>Chapter II</i></b>		
Figure (2.1)	Schematic representation of screen printed planar electrode.	<b>45</b>
Figure (2.2)	FT-IR spectra for 2,4-Dichlorophenol (DCP), DCP/molecularly imprinted polymers (MIP), MIP/washed and non-imprinted polymer (NIP) beads.	<b>47</b>
Figure(2.3)	SEM images of (a) MIP and (b) NIP beads.	<b>49</b>
Figure (2.4)	Binding isotherm for MIPs and NIPs. Conditions: 20.0 mg of polymer; $t=25\text{ }^{\circ}\text{C}$ ; $V=10.0\text{ mL}$ .	<b>51</b>

Figure (2.5)	Scatchard plot for (A) MIPs and (B) NIPs. Conditions: 20.0 mg of polymer; $t=25\text{ }^{\circ}\text{C}$ ; $V=10.0\text{ mL}$ .	<b>52</b>
Figure (2.6)	(A) The dynamic potentiometric responses of screen-printed platform towards neutral 2,4-DCP in 30 mm Tris buffer at pH 5. The inset shows the measuring calibration plot for 2,4-DCP;(B) The potential responses to $2.5\text{ }\mu\text{m}$ neutral 2,4-DCP using the blank, NIP and MIP based membranes.	<b>55</b>
Figure (2.7)	Potentiometric selectivity of MIP membrane-based sensors (A) with and (B) without polyaniline(PANI) as a solid-contact layer.	<b>57</b>
Figure (2.8)	Chronopotentiometry for DCP/MIP-ISEs (A) with and (B) without PANI as a solid contact material.	<b>60</b>
Figure (2.9)	.Impedance plot (A)for DCP/MIP -ISEs with and, (B) without PANI as a solid contact material.	<b>61</b>
Figure (2.10)	Water-layer tests for the DCP-ISE (A) with and (B) without PANI as the solid contact.	<b>62</b>
<b><i>Chapter III</i></b>		
Figure (3.1)	Structure of Sodium deoxycholate.	<b>73</b>

Figure (3.2)	FT-IR spectra for (a) NaDC, (b) NaDC/MIP, (c) washed MIP and (d) NIP beads.	<b>79</b>
Figure (3.3)	SEM images of (A) MIP and (B) NIP beads.	<b>80</b>
Figure (3.4)	Potentiometric response curves obtained screen- printed ISEs integrated with (A) MIP and (B) NIP.	<b>84</b>
Figure (3.5)	Life-span of the proposed deoxycholate membrane based sensor.	<b>85</b>
Figure (3.6)	Water-layer tests for NaDC-ISE with and without SWCNTs as the solid contact.	<b>86</b>
Figure (3.7)	Chronopotentiometry for NaDC/MIP -ISEs with (a), and without (b) SWCNTs as a solid contact material.	<b>88</b>
Figure (3.8)	Impedance for NaDC/MIP -ISEs with and without SWCNTs as a solid contact material.	<b>89</b>
Figure (3.9)	The dynamic potentiometric responses of screen-printed platform towards BSA and NaDC at pH=9.2. The inset shows the measuring calibration plot for BSA.	<b>96</b>

**List of Tables:**

<b>Chapter(II)</b>		<b>Page</b>
<b>Table (2.1)</b>	Selectivity coefficients, Log $K^{\text{pot}}_{\text{DCP,J}}$ , of the proposed screen-printed sensors.	<b>58</b>
<b>Table (2.2)</b>	Application of the proposed sensor to determination of DCP in the water samples.	<b>64</b>
<b>Chapter(III)</b>		<b>page</b>
<b>Table (3.1)</b>	<b>Potentiometric characteristics of the proposed sensors</b>	<b>83</b>
<b>Table (3.2)</b>	<b>Potentiometric selectivity coefficients, Log <math>K^{\text{pot}}_{\text{x,y}}</math> of the proposed screen-printed ISEs.</b>	<b>91</b>
<b>Table (3.3)</b>	<b>Potentiometric determination of bile acid in pharmaceutical preparations using deoxycholate membrane sensor</b>	<b>93</b>
<b>Table (3.4)</b>	<b>Application of the proposed sensor to the determination of Albumin in the Human blood Serum.</b>	<b>95</b>