Thermodynamic study of Cu(II) ion-selective membrane electrode based on bis
(N-salicylidene-3,3'-diamino diphenyl) sulfone

E. Baghdari¹, F. Fekri Lari¹, M. Giahi², S. Farhadi³ and M. Aghaei⁴,*

¹Ph.D.Student. Department of Chemistry, Science and Research Branch, Islamic Azad University, Tehran, Iran
²Department of Chemistry, Faculty of Science, Lahijan Branch, Islamic Azad University, Lahijan, Iran
³Department of Chemistry, Lorestan University, Khorramabad, Iran
⁴Faculty of Chemistry, North Tehran Branch, Islamic Azad University, Tehran, Iran

ABSTRACT
The effect of temperature on the behavior of Cu(II) ion electrode based on bis(N-salicylidene-3,3'-diamino diphenyl) sulfone (BSDDS) was studied. This electrode showed a good Nernstian response in the temperature range of 20-50 °C. Also, the behavior of the synthesized electrode was investigated in the mixed solvents "ethanol-water" and "dioxane-water".

Keywords: Temperature coefficient; Mixed solvent; Nernstian response

INTRODUCTION
The development of selective membrane electrodes based on neutral carriers is one of the most promising trends in ionometry [1]. In recent years, there has been a growing need for constructing chemical sensors for the fast and economical monitoring of pharmaceutical compounds. Ion-selective electrodes are part of a group of relatively inexpensive analytical tools which are commonly referred to as sensors [2,3] and their use in the medical area, environmental, agricultural and industrial field is developing day to day [2-6]. Copper is one of the most important elements. It distributes in the environment of industrialized countries. It almost contributes in all organisms, land and marine. Copper is an essential element for many biological processes, e.g. blood formation and the functions of many important enzymes [7-11].

In our previous work, we published some behaviors of Cu(II)-ion selective electrode based on bis [N-Salicylidene-3,3'-diamino diphenyl] Sulfone (BSDDS) which we abbreviate it as B Cu(II)ISE [12]. But in this work we have tried to study the effect of temperature and mixed solvents on the behavior of this electrode.
Reagents

All reagents except BSDDS were of analytical reagent grade but BSDDS was synthesized and purified in the laboratory of Lorestan university. Reagent grade, oleic acid (OA), tetrahydrofuran (THF), dibutyl phthalate (DBP) and high relative molecular weight PVC (all from Merck) were used as received. Nitrate salt of copper used (from Merck) and was of the highest purity available and used without further purification. Double distilled deionized water was used throughout this work.

Electrode preparation

The optimized electrode for each case of our works was prepared by mixing of 65% DBP in the presence of 30% PVC, 5% ionophore and 5% oleic acid [12].

It should be noted that the presence of lipophilic and immobilized ionic additive [13, 14] or salt of two lipophilic ions [15] could diminish the membrane resistance and eliminate the diffusion potential [16, 17].

Table 1. Some BCu(II) ISE characteristics at different temperatures

<table>
<thead>
<tr>
<th>Temperature °C</th>
<th>Slope/mV/Decade</th>
<th>$E_{cell}^{\circ}$/mV</th>
<th>$E_{ref}$/mV</th>
<th>Linear range/M</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>27.2</td>
<td>184.57</td>
<td>428.96</td>
<td>1.0 x 10^-6 to 1.0 x 10^-2</td>
</tr>
<tr>
<td>25</td>
<td>27.7</td>
<td>192.53</td>
<td>433.55</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>27.8</td>
<td>196.87</td>
<td>434.57</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>28.0</td>
<td>201.33</td>
<td>435.73</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>28.1</td>
<td>206.98</td>
<td>438.08</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>28.2</td>
<td>212.42</td>
<td>440.22</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>28.4</td>
<td>217.79</td>
<td>442.24</td>
<td></td>
</tr>
</tbody>
</table>

RESULTS AND DISCUSSION

Effect of temperature

The synthesized electrode showed a good Nernstian response in the concentration range of $1 \times 10^{-6}$ to $1.0 \times 10^{-2}$ M at 25°C. We tested this behavior at some other temperatures, 20, 30, 35, 40, 45 and 50°C and we observed that this behavior is almost consistently maintained at every mentioned temperature. The $E_{cell}^{\circ}$ at every mentioned temperature was obtained as intercept of the plot of $E_{cell}$ versus $p^{Cu^{2+}}$. The results are gathered in Tab 1.
In addition, the behaviour of electrode was studied in the mixed solvent "ethanol + water" (volume percents of ethanol 0-25%) and "dioxane+water" (volume percents of dioxane 0-10%) at 25°C respectively. The results are reported in Tab. 2.

As it is clear from the Table 2, the electrode gives a fairly good Nernstian response in the mixed solvents (E+W) and (D+W) in the studied range of concentration at 25°C.

**CONCLUSION**

The synthesized electrode gave a fairly good Nernstian response in the temperature range of 25 to 50°C in aqueous solution and in the concentration range of 1.0 x 10⁻⁶ - 1.0 x 10⁻² M. This behavior was also observed in the studied mixed solvents "ethanol+water" and "dioxane+water" at 25°C.

**REFERENCES**


