Manufacture of Lead-Specific Screen-Printed Sensor Based on Lead Schiff Base Complex as Carrier and Multi-Walled Carbon Nanotubes for Detection of Pb(II) in Contaminated Water Tests

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A novel screen-printed electrode (SPE) based on [Pb(L)] complex ($H_2L = 2-((2-(2-(2-(2\text{-hydroxy-5-methoxybenzylidene amino)phenyl)disufanyl)phenylimino) methyl)-4\text{-methoxyphenol})$) was prepared for selective determination of Pb(II) ion. The ligand and its Pb(II) complex were prepared and characterized using elemental analysis, spectroscopic (IR and 1H NMR) and molar conductance. Different individual variables were optimized using IUPAC recommendation such as graphite powder, plasticizer, amounts of [Pb(L)] complex ionophore and multi-walled carbon nanotubes (MWCNT). Their possible interactions were investigated. In this potentiometric method, fabrication of screen-printed (SPE; electrode V) and multi-walled carbon nanotubes-screen-printed (MWCNT-SPE; electrode IX) sensors was described. [Pb(L)] complex alone or with MWCNT was used as modifier in case of electrodes V and IX, respectively. Optimum composition resulted in enhancement in the sensitivity and selectivity of the SPE toward Pb(II) ions significantly over the concentration range of 1.0×10^{-7} – 1.0×10^{-1} and 4.6×10^{-8} – 1.0×10^{-1} mol L⁻¹ of Pb(II) with detection limit of 1.0×10^{-7} and 4.6×10^{-8} mol L⁻¹ and a Nernstian slope of 28.98 ± 0.92 and 30.28 ± 0.70 mV decade⁻¹ for electrodes V and IX, respectively. No significant change in response was observed over the pH range of 3.0–8.0 and 2.5–8.5 with response time lower than 9 and 7 s for electrodes V and IX, respectively. The potentiometric selectivity coefficients were calculated and the results obtained showed the good selectivity of the modified SPE electrodes (V and IX) for Pb(II) ion over other metal ions. Finally, these electrodes were precisely applied for the determination of Pb(II) ions in real spiked water samples. The results obtained using both the proposed potentiometric method and atomic absorption spectrometer (AAS) showed satisfactory agreement.

Keywords: Screen-printed electrodes; Schiff base; Pb(II)-Schiff base complex; Real water samples.

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