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Miniaturized Potentiometric Ag/AgCl Reference Electrodes for Electrochemical Systems

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ABSTRACT

The present work focuses on the development of a potentiometric Ag/AgCl reference electrode using electrochemically growing silver chloride (AgCl) over the surface of silver electrodes. Based on electrochemical deposition method, AgCl was grown on screen-printed Ag electrodes in 1M potassium chloride (KCl) solution. This electrode was fabricated for use as a highly cost-effective reference electrode.

Keywords: Ag/AgCl electrode, Electrodeposition, Potentiometry, Chronopotentiometry.

1. Introduction

The continuous growing interest in the development of new miniaturized, low cost electrochemical sensors suitable for use in online quality monitoring has raised the need for the development of new miniaturized, planar reference electrodes. The response of any electrochemical potentiometric electrode is meaningless without a reference electrode against which comparison can be made[1]. Silver/Silver Chloride (Ag/AgCl) reference electrodes are commonly used in electrochemical measurements owing to their low costs and easy applicability[2]. Ag/AgCl electrodes have several advantages such as resistance to high temperatures, easy preparation and can be simplified in shape[3]. In this experiment, the sensing layer of silver chloride (AgCl) was formed by chronopotentiometry method. The performance test was evaluated by potentiometric measurements and energy dispersive spectrophotometry (EDS) technique to confirm their electrochemical performance and the presence of Ag/AgCl layer.

2. Experimental

In this study, the electrode was immersed in 1M potassium chloride (KCl) solution with applying currents of either 0.2 or 1.0 mA for 2min. The performance of Ag/AgCl electrode was confirmed by



Figure 1: Electrochemical cell system potentiometric measurements and chronopotentiometry method with three electrodes system, based on a potentiostat type VMP3. Figure 1 represents the photo of test experiment

3. Results and discussion

A chemical analysis of the electrode was performed using Energy Dispersive Spectrophotometry (EDS). The elements Ag, Cl, C, and O were detected, as expected (Figure 2). From the results, it can be surmised that AgCl thin film layer was indeed formed on the surface of the Ag thick film.



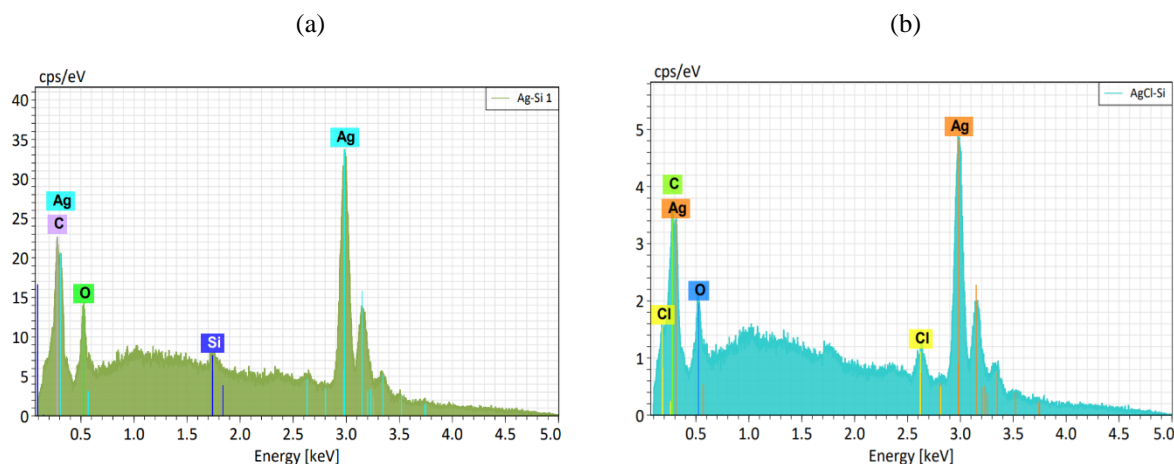


Figure 2: Energy Dispersive Spectrophotometry (EDS) analysis of the electrode surface before (a) and after (b) the chlorination process.

4. Conclusion

The successful development of the AgCl layer, demonstrated by the presence of chloride elements subsequent after the electrochemical chloridization of the surface of screen-printed silver electrodes, lays a robust foundation for further testing and ongoing optimization of this method.

References

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