The Effects of Electrolyte Chemical Composition, Concentration and pH on the Electrochemical Redox Reactions

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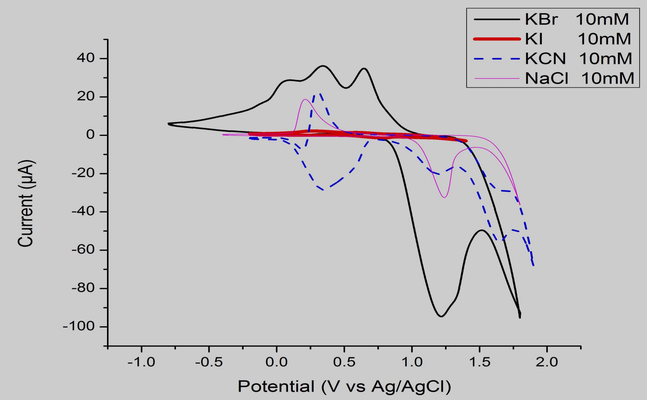
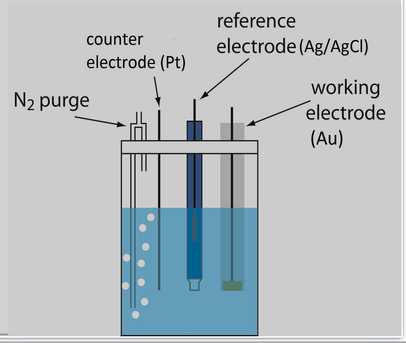
Introduction

Electrolyte composition, concentration and pH have long been known to play a role in the electrode-electrolyte interface. However, detailed studies are lacking. Cyclic voltammetry (CV) is a widely used electrochemical technique for obtaining qualitative information in electroanalysis. It measures the number of electrons transferred and intermediates formed during reduction-oxidation (redox) reactions by observing its current intensity and position of peak potential with applied voltages. In this study, we investigate systematically the redox potential of the different electrolytes under various conditions in electrolyte composition, concentration and pH.



Background

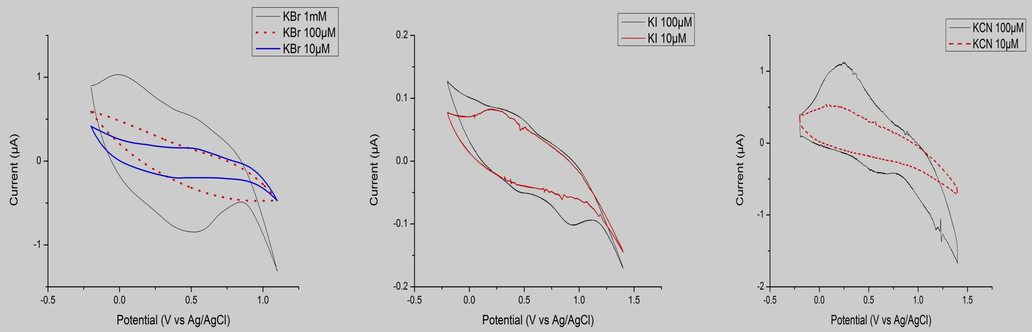
CV is often the first experiment performed in an electrode surface in an electrochemical study. This is accomplished by using a three-electrode system including working electrode (WE), counter electrode (CE) and reference electrode (RE). In this work, our system consists of gold (Au) WE, platinum (Pt) CE and silver/silver-chloride (Ag/AgCl) RE.



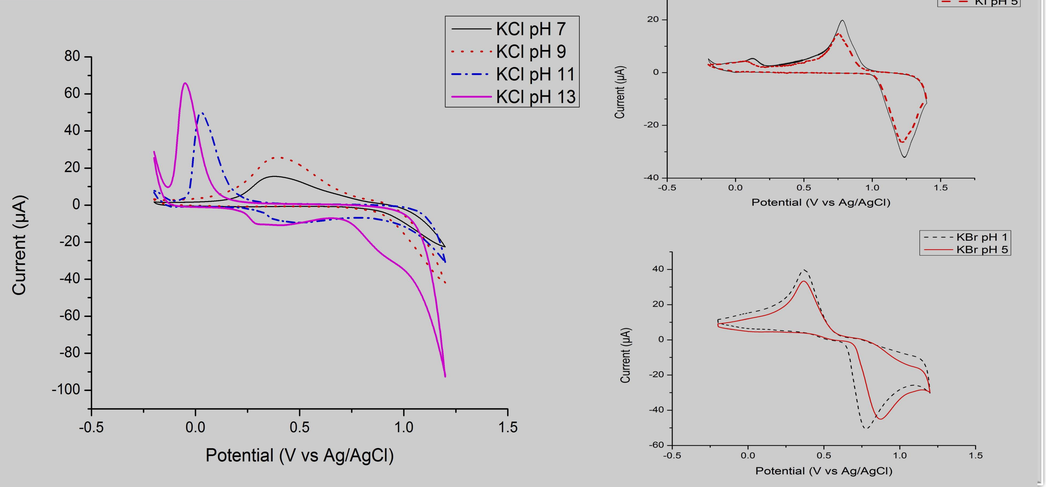
Method

Cyclic voltammograms were collected using an electrical-chemical station in the electrolyte at a scan rate of 100 $mV \cdot s^{-1}$. The scan was ranged between −0.2 V to 1.4 V. Prior to the scan, each solution is degassed with N_2 to remove dissolved O_2. The solution is not stirred during the analysis to obtain solid lines. All experiments for different compositions with pH, ionic strength and concentration dependence were performed at room temperature. Various electrolyte compositions, including KI, KBr, KSCN, KCN, KCl, and NaCl, are prepared in the range of 10 μM-1M. pH effects of each electrolyte composition were investigated in the following conditions: 1, 3, 5, 7, 9, 11, and 13.

Concentration Dependence



pH Dependence

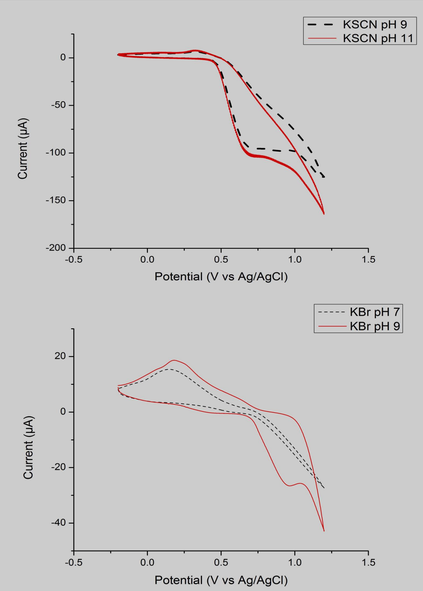


Conclusion

- Different electrolyte composition results in different redox reactions.
- Concentration dependence was found using various electrolyte.
- Both anodic and cathodic peaks from the CVs decreased in current values as concentration of each electrolyte solutions were reduced.
- The pH dependence was observed among all electrolytes compositions.
- At acidic conditions (pH<7), results showed that anodic peaks were decreased in current; whereas cathodic peaks were increased in current, as pH values went lower.
- At alkaline conditions (pH>7), anodic peaks were increased and cathodic peaks were decreased as basic pH became more basic.

Future Work

- Investigate the effect of ionic strength on the electrochemical redox reactions.
- Study the effect of varying temperature on the electrolyte compositions.



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