

Abstract

# Redox Cycling Realized in Paper-Based Electrochemical Biosensor for Highly-Selective Detection of Potassium Ferrocyanide in the Presence of Ascorbic Acid †

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Redox cycling is a phenomenon that occurs for redox species due to close interelectrode distance. Two electrodes, the generator electrode (GE) and the collector electrode (CE), can detect steady-state current which are oxidation and reduction current when those are held at oxidation and reduction potential. Using redox cycling, redox species such as dopamine can be measured in the presence of interfering irreversible species [1–3]. However, redox cycling needs expensive micro-fabrication process for electrode arrangement.

In this work, we show detection of potassium ferrocyanide (Ferro) in the presence of ascorbic acid under redox cycling condition using paper-based biochemical sensor (PBBS). PBBS has a feature which defines the interelectrode distance by the thickness of paper (180  $\mu\text{m}$ ) without any micro-fabrication process [4]. To define the interelectrode distance, we sandwiched chromatography paper (ChrPr) between two gold plates (5 mm  $\times$  10 mm) acting as GE and CE. Mixed solutions were prepared by adding Ferro (0, 1, 3, 6, 10 mM) to phosphate buffered saline (PBS) in the presence or absence of 10 mM L(+)-Ascorbic Acid Sodium Salt (L-AAS). Ferro and L-AAS are known as reversible and irreversible species, respectively. Measurements of each solution were performed through chronoamperometry (CA) technique by applying constant oxidation potential (+500 mV) and reduction potential (−200 mV) to GE and CE, respectively.

As a result, we obtained the reduction current from Ferro, not from L-AAS. These results indicated that the electrochemical current flowing through CE were due to electron transfer to the redox species. Steady-state current of mixtures obtained in CE were in agreement with the result of Ferro solution. Thus, these experimental results indicate that our sensor can selectively detect reversible redox species by excluding the interfering irreversible species. This study suggests potential applications such as the measurement of dopamine.

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**Conflicts of Interest:** The authors declare no conflict of interest.

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