

Studies of the Permeabilities of Sol-gel Ceramic Films  
on Glassy Carbon Electrodes to  $\text{Fe}(\text{CN})_6^{3-}$ ,  $\text{Fe}^{3+}$  and  
Hydroquinone

Fang Chen and Soo Beng Khoo\*

Abstract

The main objective of this research is to investigate the ingress (and egress) of ions and neutral compounds into sol-gel ceramic films on glassy carbon electrodes by electrochemical techniques. It is hoped that through these studies, we can better understand the interactions between these substances and the sol-gel matrix. Thus, sol-gel ceramic films on glassy carbon electrodes were prepared from methyltrimethoxysilane precursor. The permeabilities of  $\text{Fe}(\text{CN})_6^{3-}$ ,  $\text{Fe}^{3+}$  and hydroquinone into these films were studied under various conditions by cyclic voltammetry. The results indicated that these three redox species could permeate into preformed sol-gel ceramic films from solutions to varying degrees depending on solution conditions and nature of the substances. The quantities of the ingressed substances were estimated from their cyclic voltammograms. The cyclic voltammograms (and electrochemical behaviors) of the three ingressed species within the sol-gel environment were significantly influenced by factors such as solution pH and nature of the supporting electrolyte. The amount of each substance incorporated into the sol-gel film depended on the solution concentration and time of immersion, reaching equilibrium for a sufficient length of immersion time (usually within 20 minutes). At high concentration, saturation of the sol-gel film for the intack of these three substances could be achieved.