



# CAPSULES

notes and applications from Bioanalytical Systems, Inc.

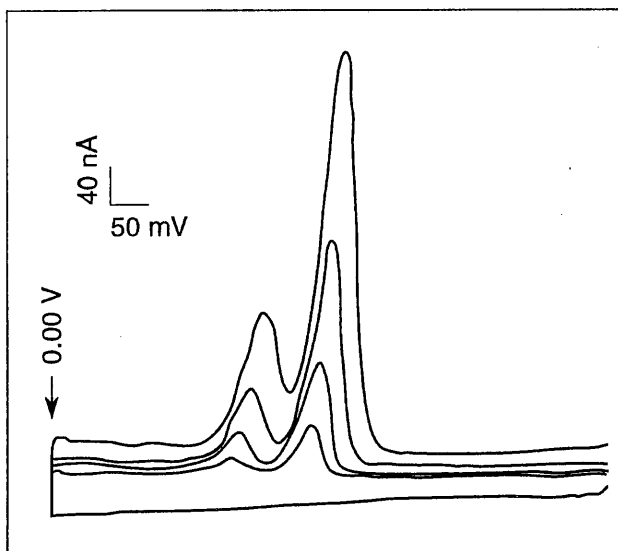
## Determination of Vanadium by Adsorptive Stripping Voltammetry

### Purpose

In this Capsule, a method for the trace determination of vanadium in environmental matrices (e.g., river water) is described.

### Purpose

The basis of electrochemical trace analysis is the accumulation (or pre-concentration) of the analyte at the working electrode before the potential scan. In Adsorptive Stripping Voltammetry (AdSV), this accumulation occurs via non-electrolytic adsorption of the analyte on the surface of the working electrode (the mercury drop electrode is most commonly used). AdSV can be used for the detection of metal ions via the adsorption of metal ion complexes.

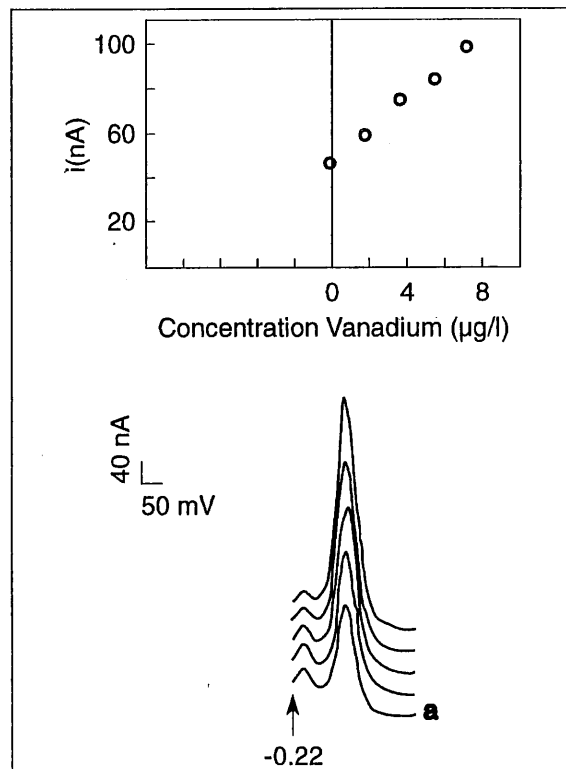


**Figure 1.** Cyclic voltammogram of a solution of vanadate(V) ( $3.8 \times 10^{-7}$  M) and Solochrome Violet RS ( $1.2 \times 10^{-6}$  M) in acetate buffer (pH 3.7). Scan rate =  $100 \text{ mV s}^{-1}$ . Figure adapted from primary reference.

### Results

In this study, the complex of vanadium with Solochrome Violet RS was used. The cyclic voltammogram of a solution containing both vanadium ions ( $3.8 \times 10^{-7}$  M) and Solochrome Violet RS ( $1.2 \times 10^{-6}$  M) is shown in F1. There are two reductions; the

reduction at the more positive potential is due to the metal-ligand complex and the other is due to the free ligand. Differential pulse voltammetry was used for the AdSV experiment. The optimum experimental conditions were found to be as follows: 0.02 M acetate buffer (pH 3.7),  $2 \times 10^{-6}$  M Solochrome Violet RS, accumulation potential =  $-0.22 \text{ V}$  and accumulation time = 30 s (it is important to note that, although the accumulation is non-electrolytic, the accumulation potential can affect the rate of accumulation by changing the electrostatic forces between the mercury surface and the complex). Under these conditions, the current response was linear over the range 1.9 - 9.4 ppb, and a detection limit of  $1.7 \times 10^{-10} \text{ M}$  was estimated for an accumulation time of 300 s.



**Figure 2.** Stripping voltammograms and standard addition plots for the analysis of vanadium in river water (voltammogram (a) is the sample). Figure adapted from primary reference.

The above analysis was used for the determination of vanadium in river water and sea water, using the method of standard additions for quantitation. The voltammograms and standard additions plot for river water is shown in F2.

Catechol [1] has also been used for the determination of vanadium.

*Reference*

*Cathodic Stripping Voltammetry of Vanadium Based on Adsorptive Accumulation of Its Solochrome Violet RS Complex at the Static Mercury Drop Electrode, P.A.M. Farias and I. Takase, Electroanalysis 4 (1992) 823-828.*

*Additional Reference*

- 1) C. M. G. van den Berg and Z. Q. Huang, *Anal. Chem.* 56 (1984) 2383.

