

Short Communication

Determination of microgram quantities of Co(II) by a polarographic catalytic method

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Abstract

The polarographic reduction of cobalt(II) in acetate buffer solutions showed an interesting behaviour in the presence of iodate. A new wave with a kinetic nature, a sharp peak and large currents is noticed around -1.35 V vs SCE. The influence of various parameters on the characteristics of the kinetic wave is investigated. A method for the determination of micro quantities of cobalt(II) is reported.

Key words: Polarography, catalytic wave, cobalt, iodate, peak current.

1. Introduction

In a previous paper¹, characteristics of the catalytic reduction wave at the d.m.e. of iodate in the presence of zirconium(IV) in the bulk of the solution, has been presented and discussed. In further work we have studied the catalytic effect of cobalt(II) on the polarographic reduction of the above anion and the results are communicated hereunder.

2. Experimental

For experimental details and chemicals used, reference is made to a previous paper¹. A 0.1 M solution of cobaltous chloride was used in these investigations. The capillary used has the following characteristics at 0 V vs SCE in distilled water, $t = 4.85$ sec; $m = 1.4226$ mg/sec at $h = 90$ cm.

3. Results and discussion

In the potential region corresponding to the reduction of cobalt(II) to cobalt(0) (around -1.35 V vs SCE), a catalytic polarographic current is observed in an acetate buffer solution containing iodate ion. The effect of pH revealed that the magnitude of the peak

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current is maximum in solutions of pH 5.0. Hence pH 5.0 was chosen as the optimum. The abnormal currents, the non-dependence of the peak current on the mercury column height, the large temperature coefficient value and its strong dependence on the iodate concentration clearly indicates the catalytic nature of the wave and that it may be due to a chemical reaction. The chemical reaction involving cobalt(0) and iodate resulting in the regeneration of cobalt(II) at the d.m.e. is responsible for the observed phenomenon. The peak current varied linearly with cobalt(II) concentration (0.59–7.08 $\mu\text{g/ml}$) as well as iodate concentration ($10\text{--}20 \times 10^{-3}$ M). The possibility has been explored of determining microgram quantities of cobalt(II) in solution. Tests on reproducibility and accuracy for a solution of 14.73 μg of cobalt(II) revealed the value of standard deviation and relative standard deviation to be 0.16 μg and 1.09% respectively.

Recommended procedure: 1–12 ml of cobalt(II) solution (2.5×10^{-4} M), 3 ml of iodate solution (0.1 M) and a required volume of distilled water are taken in a 25 ml standard flask. The solution is made up to the mark with acetate–acetic acid buffer solution (0.2 M) of pH 5.0 and transferred to the polarographic cell after thorough shaking. Pure nitrogen gas is passed for about 15 minutes and the polarogram is recorded. The peak current is measured and the amount of cobalt is obtained from a pre-determined calibration curve between the peak current and the metal ion.

Interference studies: 100-fold excess of Cl^- , Br^- , I^- , SO_4^{2-} , CO_3^{2-} , ferricyanide, 25-fold of Zn(II), Cu(II), Cd(II), Fe(II), Mn(II), Cr(III) and 10-fold of Mo(VI), W(VI), U(VI), Fe(III), Zr(IV), Ni(II) do not interfere. High concentrations of thiosemicarbazide and EDTA suppress the wave to a marked extent.

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Reference

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