Simultaneous determination of Ti(IV) and Ru(III) using 3,4-DHBINH
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Ti(IV) and Ru(III) do not show complexation reaction with many organic compounds. Only few methods are available for the individual determination of Ti(IV) and Ru(III). The results relating to simultaneous determination of Ti(IV) and Ru(II) are presented in this chapter.

Figures 4.4.1 and 4.4.2 represents the zero order spectra of Ti(IV) and Ru(III) in a solution of pH 6.0. The $\lambda_{\text{max}}$ for these two systems are 420 and 360 nm respectively. When a zero order spectrum is recorded for a solution containing both the metal ions only one peak is noticed at 390nm.

Zero order spectrum is not useful for the simultaneous determination of both the metal ions.

Hence, the author has made attempts to use first order spectrum for simultaneous determination. The results are not fruitful and hence, second order derivative spectrophotometry is used for simultaneous determinations.

A series of solutions containing varying concentration of ruthenium(III) and titanium(VI) are prepared. A 30 fold concentration of reagent is taken to complex both the metal ions. The solution is made up to the mark by adding a buffer solution of pH 6.0.

A blank solution is prepared on the same lines as in earlier systems.

The second order spectrum recorded for experimental solution against the respective blank is presented in figure 4.4.5. An examination of the figure reveals
that there are two peaks corresponding to the two metal ions. The peak at 374 nm corresponds to Ru(III) and the one at 358 nm corresponds to Ti(IV). The author has recorded individual second order spectra for Ru(III) and Ti(IV). The peak values are determined in each case.

The peak at 374 nm and the valley at 380 nm corresponds to Ru(III). Similarly the peak at 358 nm and the valley at 367 nm correspond to Ti(IV).

The peaks for the two metals differ by more than 15 nm and also the valleys. Hence, the second order derivative spectrum can be used for the simultaneous determination of Ru(III) and Ti(IV). Typical second order derivative spectrum is shown in figure 4.4.4.

**Simultaneous determination of Ru(III) and Ti(IV)-present method**

In the present method concentration of both the metal ions are varied keeping the reagent concentration constant. Blank solutions are also prepared on the same lines, but without containing metal ions. For each of the solution the second order derivative spectrum is recorded. These are shown in figures 4.4.5. Graphs are plotted between the concentration of Ru(III) and Ti(IV). Linear plots are obtained in the case of ruthenium and titanium when graphs are plotted between concentration and peak amplitude or valley amplitude, sum of peak and valley amplitudes.

It may be mentioned here that straight line plots are obtained even with the sum of peak and valley amplitudes. These linear plots are shown in figs. 4.4.7 and 4.4.6 for Ru(III) and Ti(IV) separately.
Thus the second order derivative spectrophotometric method is very useful to make simultaneous determination of Ru(III) and Ti(IV) in microgram quantities. Using the sum of peak and valley amplitudes it is possible to achieve greater sensitivities. The simultaneous determination can be carried out for mixtures containing both the metal ions and separation is not necessary. This derivative method can be used for the analysis of alloys or simulated mixtures containing both the metal ions.
Fig. 4.4.1 Zero order spectrum of Ti (IV) in presence of 3,4-DHBINH
[3,4-DHBINH] = 1 x 10^{-3} M ;
[Ti (IV)] = 1 x 10^{-4} M ;
pH = 6.0

Fig. 4.4.2 Zero order spectrum of Ru (III) in presence of 3,4-DHBINH
[3,4-DHBINH] = 1 x 10^{-3} M ;
[Ru (III)] = 1 x 10^{-4} M ;
pH = 6.0
Fig. 4.4.3  Zero order spectrum of Ti (IV) + Ru (III) in the presence of 3,4-DHBINH
[3,4-DHBINH] = 3 x 10^{-3} M;
[Ru (III)] = [Ti (IV)] = 1 x 10^{-4} M;
P\text{H} = 6.0

Fig. 4.4.4  Typical second order derivative spectrum of Ru (III) + Ti (IV)
in presence of 3,4-DHBINH
[3,4-DHBINH] = 3 x 10^{-3} M;
[Ru (III)] = [Ti (IV)] = 1 x 10^{-4} M; pH = 6.0
Second order spectra of Ru (III) + Ti (IV) in presence of 3,4-DHBINH

[3,4-DHBINH] = 3 x 10^{-3} M;

[Ru (III)] = [Ti (IV)] = 1 x 10^{-4} M;

pH = 6.0

Fig. 4.4.5
4.4.6 Second derivative amplitude Vs Concentration of Ti (IV)  
Wavelength = 359 ; pH = 6.0  
a = Peak ; b = Valley ; c = Peak + Valley

Fig. 4.4.7 Second derivative amplitude Vs Concentration of Ru (III)  
Wavelength = 374 ; pH = 6.0  
a = Peak ; b = Valley ; c = Peak + Valley

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