

COBALT-VANADIUM COATING ELECTRODEPOSITION FROM CITRATE ELECTROLYTE

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Many studies have been devoted to clarifying the forms of the vanadium state in aqueous solutions, but this issue is still far from being fully resolved. The peculiarity of the vanadium (V) chemistry is that its state in aqueous solutions depends on the environment pH, concentration and potential in the system. The variety of vanadium ionic forms in solutions leads to the formation of a large number of compounds with different ratios of metals and vanadium, as well as complex compounds with inorganic and organic ligands. Organic acids reduce pentavalent vanadium to trivalent and tetravalent vanadium with the formation of vanadyl-ions.

Adding vanadium oxide (V) to a solution of sodium citrate results in formation of a yellow solution containing vanadate ions, which includes pentavalent vanadium. Over time, the color changed to green and then to dark blue, which may indicate the reduction of vanadium (V) compounds to vanadium (III) with the formation of vanadium (III) complex ions $[V(C_6H_5O_7)_2]^{3-}$. This solution of mentioned vanadium (III) complex ion oxidizes by air to form oxovanadium (IV) citrate complexes $[VO(C_6H_5O_7)_2]^{4-}$. Treating the resulting solution with cobalt sulfate leads to the electrolyte containing both cobalt and oxovanadium (IV) citrate complexes.

Taking into account the electrochemical (k_s) and chemical reactions (k_f) rates, the ionic product of water (k_w), the ad-atoms ($)_{ads}$ or atoms of crystalline lattice ($)_{cr}$ formation, the course of partial reactions **a** and **b** during deposition of cobalt-vanadium coating from the obtained electrolyte can be given by the scheme (Fig. 1):

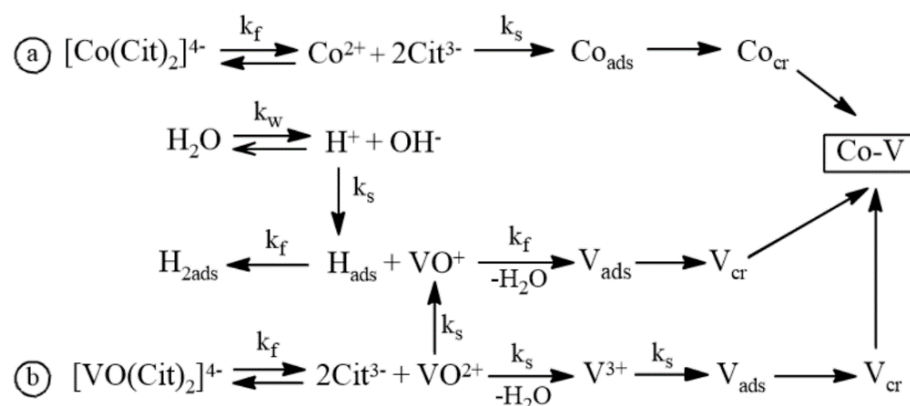


Fig. 1. Scheme of the partial reactions course during the cobalt-vanadium coating deposition

It is important to note, that during the pulse period, the electrochemical reduction of cobalt, hydrogen and oxovanadium (IV) VO^{2+} ions take place. The VO^{2+} ions can be reduced to trivalent vanadium in the form of V^{3+} cation or oxo-cation VO^+ . During the pause period, VO^+ is additionally chemically reduced by adsorbed hydrogen atoms, which were formed in the electrochemical process during the previous pulse period.