Electrochemical behavior of hydrogen peroxide at carbositall electrode

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Hydrogen peroxide (H_2O_2) is neorganic peroxide belonging to the family of oxygenreleasing agents. Hydrogen peroxide and other peroxides are involved in a wide variety of industrial processes. Hydrogen peroxide is used as disinfecting and bleaching agent with applications ranging from the medical, pharmaceutical and paper industry to household washing powder, and they are also are attractive reactants for decontamination of chemical warfare agent.

The aim of the research was to investigate the electrochemical behavior of H_2O_2 by cathodic voltammetry using carbositall electrode, as indicating electrode. Electrochemical measurements were carried out in the analyzer AVS-1.1 (Volta, St. Petersburg) with a three-electrode scheme by alternating current mode with square wave modulation in potential range +1.0…–1.0V, W=1000 rpm, amplitude 40mV, ν=65Hz. CE was used as a working and an auxiliary electrode, and Ag, AgCl /KCl (sat) electrode type EVL-1M4 as a reference electrode.

It was experimentally proved that height of H_2O_2 reduction peak decreases and potential of reduction peak is shifted toward more electronegative values with increasing of background electrolyte pH from 1.4 to 4.5. The maximum peak (I_p) occurs at a pH approximately 2,2 and at a pH around 4 analytical signal almost disappears. The effect of pH on peak potential (E_p) shows the following: when pH value increases in the interval from 2 to 3, E_p remains almost constant, but E_p decreases sharply to negative value with pH increasing over 3.5. So, the optimal peak for the analysis (E_p=+0.16V) was obtained at pH≈2.2-2.4 on the background of Na_2SO_4 and mol L^{-1} $KHSO_4$.

The voltammetric study was conducted in solutions with a concentration of H_2O_2 from 1.7×10^{-5} to 10.2×10^{-5} mol L^{-1}. The peak was obtained at E_p= +0.16 V, whose height was rising proportionally to H_2O_2 concentrations increasing. Linear concentration ranges of H_2O_2 varied from $(1.70–10.20)\times10^{-5}$ mol L^{-1}. It is $I_p = (8,6\pm0,3)\times10^5\times c$ (r = 0.998); LOD = $6,16\cdot10^{-6}$ mol L^{-1}, LOQ is $2,05\cdot10^{-5}$ mol L^{-1}. The high sensitivity of this method is accompanied by very good reproducibility. The reproducibility was evaluated from 5 repeated electrochemical signal measurements of model solutions with 5.10×10^{-5}, 6.80×10^{-5} and 8.50×10^{-5} mol L^{-1} concentrations of H_2O_2. The precision of the developed method in terms of the relative standard deviation (RSD) were 4.24 %, 3.27 % and 2.87 %, respectively (n = 5, P = 0.95).

Thus, the electrochemical behavior of H_2O_2 at carbositall electrode was investigated and optimal conditions for its quantitative analysis were established.