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ADSORPTION OF FLAVONOIDS ON A PLATINUM ELECTRODE

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Natural flavonoids are interesting because of their wide spectrum of pharmacological activity [1]. We studied the adsorption of certain natural flavonoids on Pt. Adsorption of the starting flavonoids and their transformation products has a substantial effect on the kinetics and mechanism of electrode processes. The strength of the interaction of the supporting electrolyte with the solvent and the reacting organic compound must also be considered. The activity coefficient of the reacting molecules and the reaction rate in general depend on these parameters.

Adsorption of the starting material and final products usually depends on the electrode potential. This significantly complicates the study of electrode processes, especially on Pt-group metals, owing to the necessity to consider the surface energy inhomogeneities [2]. The differential capacity of the electrical double layer (EDL) is exceedingly sensitive to adsorption of organic molecules on the electrode surface. Despite several complications and limitations, using a bridging scheme for measuring the EDL capacity enables the most important aspects that are necessary to optimize the preparative synthesis to be measured. These are the adsorption itself, the regions and basic principles of adsorption, and the kinetics, if necessary.

Figure 1 presents the standard Pt-electrode surface filling as a function of the logarithm of the flavonoid bulk concentration in methanol. This plot is linear at low concentrations (from 10^{-6}-10^{-2} M for myricetin and 10^{-6}-10^{-4} M for apigenin) and is described by a Temkin isotherm [3]. The limiting surface filling by flavonoids occurs at concentrations above 10^{-2} M. It is noteworthy that the adsorptivity, like the adsorption rate, depends on the flavonoid structure.

If the anodic potentiodynamic pulse is rapid, the curves exhibit oxidation waves of chemisorbed substances at $E > 1.2$ V. An analysis of the curves indicates that all of the chemisorbed substance is oxidized during the time of one pulse because the curve obtained if a second control pulse is applied practically completely coincides with the curve obtained in the supporting electrolyte.

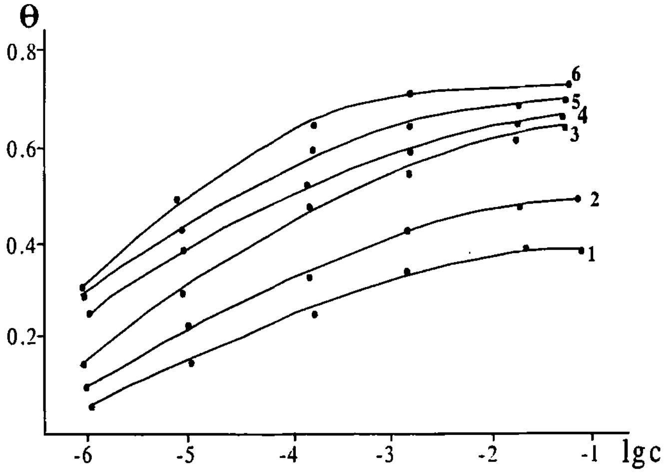

Fig. 1. Extent of Pt-electrode surface filling (arithmetic mean) as a function of flavonoid concentration: myricetin (1), rhamnetin (2), quercetin (3), catechin (4), luteolin (5), apigenin (6). $E = 1.0$ V, supporting electrolyte H_2SO_4 (1 M) + methanol.

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The number of electrons consumed at one adsorption site depends on the Pt-electrode potential and is practically independent of the adsorption time and substrate concentration.

Thus, all studied flavonoids adsorb to the Pt electrode in the potential range 0.4-1.2 V and are oxidized at $E > 1.2$ V. The molecular rings, which presumably are planar and interact with the π-electrons of the electrode surface, have a significant influence on the degree of adsorption. The adsorptivity also depends on the substituents in the benzene ring. The adsorption is less if more substituents, e.g., OH groups, are present and the molecular weight of the flavonoid is higher.

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