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Determining the second-harmonic signal in electrochemical systems

- Dz. I. Dzhaparidze,
- T. A. Marsagishvili,
- M. N. Machavariani &
- V. A. Chagelishvili

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Abstract

Processes of adsorption and desorption of the butanol-1, butanol-2, hexanol, pentanol, and isoamyl alcohol molecules on a mercury electrode are studied with use made of the method of a second-harmonic signal in the region of radiowave frequencies. Two potentials are simultaneously applied to the metal/solution interface, specifically, a constant potential and a weak variable potential. The magnitude of the constant potential is close to the corresponding potential of adsorption and the variable potential has an amplitude in the limits of 2 to 20 mV and a frequency varying from a few tens of hertzs to a few tens of kilohertzs. Despite the absence of charge transport during the adsorption between the alcohol molecules and the electrode, the quadratic dependence between a signal of electromagnetic radiation of the radiowave frequencies U and the amplitude of the variable potential E_{v1} applied to the metal/solution interface is discovered for all peaks in the curves of the second-harmonic signal for various concentrations of alcohols, various frequencies, and various values of the amplitude of the variable potential. Investigations for systems containing chlorides of sodium, potassium, and cesium in addition to ethylene glycol are conducted. According to an analysis of obtained experimental data, the number of peaks increases with decreasing concentration of chlorides, whereas the size of the sodium, potassium, and cesium cations makes no impact on the magnitude of the emitted signal. At the same time, diminishing the concentration of the chlorides leads to a certain amplification of the signal.

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