AN EQUIVALENT ELECTRIC CIRCUIT APPROACH TO THE STUDY OF HYDROCARBON OXIDATION KINETICS

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ABSTRACT

A technique for the determination of the frequency response of an electrochemical system between 1 Hz and 10 Hz is described and applied to the study of the anodic oxidation of hydrocarbons. Special emphasis is placed upon the treatment of data in the frequency domain. Thus, it is shown that the combined use of specific frequency functions of the real and imaginary parts of the measured impedance as well as the phase angle, magnitude and Argand functions constitute a powerful method to establish an equivalent electric circuit for hydrocarbon oxidation, In addition, the concept of total electrode impedance is used to permit the evaluation of the double layer capacity in the presence of the electrode reaction. It is shown that appropriate treatment of frequency response data obtained over a wide enough frequency range allows a unique circuit to be obtained under the particular conditions of the experiment. The equivalent electric circuit thus established is compared with those obtained from an analysis of the reaction schemes which have been proposed by other workers. In this respect, the method of establishing equivalent circuits representative of a given reaction scheme is discussed in detail and it is shown that each mechanism has a unique circuit. The variation of impedance as a function of potential and of reactant gas is studied allowing the possibility of detecting changes in reaction mechanism at different steady-state potentials.