LETTERS TO THE EDITOR

ADSORPTION AND EVOLUTION OF HYDROGEN ON PLATINUM MICROCRYSTALS DEPOSITED ON PYROLITIC CARBON

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The work was done with the aim of studying the electrochemical properties of very small quantities of platinum catalysts on a carbon carrier. Platinum was deposited electrochemically on smooth pyrolytic-carbon electrodes from H_2PtCl_6 or Na_2PtCl_6 solutions, calculating so that the microcrystals of platinum would cover only a small part of the electrode surface area and that the electrode would remain nonporous. Hydrogen adsorption was determined by taking potentiodynamic I-φ curves in 1 N H_2SO_4 in the range of potentials, φ_r, from 0.4 to 0.025 V. When taking such curves over a range of scan rates, ν, from 0.2 to 20 V/sec a dependence of the amount of electricity, Q_H, on ν was observed, viz., Q_H was proportional $\nu^{-1/2}$, while for smooth solid platinum under the same conditions, Q_H does not depend on ν. The true surface area of the deposited platinum, S_{tr}, was determined from the hydrogen adsorption measured at ν = 20 V/sec; taking into account the possibility that Q_H is reduced further when ν increases, the value of S_{tr} thus found is somewhat exaggerated.

The rate of hydrogen evolution as referred to unit true surface area rises for various deposits at φ_r from -0.02 to -0.05 V (the Tafel region) with their specific surface area, S_{tr}/weight of Pt (i.e., with the decrease in the size of the crystallites), and with decreasing degree of coverage of the carbon electrode surface by platinum crystallites. At a ratio of S_{tr} of platinum to apparent surface area of the electrode of 0.05 to 0.1, the rate of hydrogen evolution is 6-8 times greater than the rate on smooth platinum; taking into account the exaggerated value of S_{tr} measured, the effect of rate increase is possibly even higher.

Both the descriptions of the effect can, in our opinion, be linked to the participation of portions of the carbon surface next to the platinum microcrystals in the adsorption and evolution of hydrogen.

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