JOURNAL OF CATALYSIS 19, 236 (1970)

LETTER TO THE EDITORS

Amount of Surface Covered by Promoter on an Iron Synthetic-Ammonia Catalyst

Recently Solbakken *et al.* (*1*) were concerned again with the question of how much of the surface of promoted iron catalysts for ammonia synthesis might be covered by the promoter. In earlier papers Emmett and Brunauer (*2*) had shown by means of adsorption experiments that a few percent of promoter in a catalyst would cover 50–70% of the surface of the iron, whereas Scholten (*3*) had criticized the experimental procedure of the authors and by his experiments had come to the conclusion that only 25% of the surface of the iron is covered. Even though the latest work of Emmett and co-workers seems to prove that the high figure of the coverage is right, another observation will be reported here which also supports the larger values of Emmett and co-workers. Brill and Tauster (*4*) have shown that ammonia synthesis with a singly-promoted alumina-containing catalyst requires exactly the same activation energy as with an unactivated one. Consequently, at the same temperature, the ratio of the value of the rate constant of both catalysts should be equal to the ratio of the surfaces. In Tables 2 and 3 of that paper k-values are given for a pure iron catalyst and an activated one (3% Al_2O_3), respectively. For both catalysts measurements are taken at 300°C and at exactly equal conditions. The corresponding k-values are 0.022 and 0.117, respectively. The surface of the catalyst was measured by means of the BET method and gave 1.5 m^2/g for the unactivated and 20 m^2/g for the activated one. From the ratio of the rate constants one obtains for the active surface of the activated catalyst 8.0 m^2/g. Consequently the coverage of the iron surface of the activated catalyst is 60%, in excellent agreement with the most recent measurements of Emmett and co-workers (*1*). (If all the measurements of Tables 2 and 3 are taken into account, i.e., if an equation,

$$s_1 = s_0(k_1/k_0)\exp[(Q/R)(T_1^{-1} - T_0^{-1})],$$

is used with $s_0 = 1.5$ m^2/g and $Q = 22.5$ kcal/mole, a mean value of $8.1 \pm 0.5 m^2/g$ is obtained for the active surface of the activated catalyst.)

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Received June 23, 1970