SHORT COMMUNICATIONS

Decomposition of Aqueous Hydrogen Peroxide by Oxidized Chromia-Alumina Catalysts

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Our previous work[1] has established the fact that chromia-alumina catalysts contain an excess of surface oxygen after contact with air even at room temperature. In the extreme case, it has been shown that chromic ion can be oxidized completely to the plus-six state in sharp contrast with our knowledge of the thermal decomposition of chromic anhydride. Voltz and Weller[2] examined the catalytic decomposition of aqueous hydrogen peroxide by chromic oxide catalysts treated with oxygen at 500°C and suggested that the activities of the oxidized catalysts can be largely attributed to the chromic anhydride or its equivalent formed on the surface of these catalysts. However, their prediction was supported by measurements on three samples only, chromina gel, 20% chromia-alumina (Houdry Type R), and co-precipitated chromia-alumina. As we had many samples of various concentrations of chromium and also various degrees of oxidation, a more detailed examination of the relation between catalytic activity for the decomposition of aqueous hydrogen peroxide and the content of excess oxygen, has been undertaken.

The catalyst samples used in this study are those of the first series in our previous paper and the temperatures of oxygen treatments are 250°, 350° and 450°C. The content of excess oxygen, determined by an iodometric titration, ranges from 0.34 to 2.83 mg. eq./g. of catalyst and these amounts of excess oxygen cover the range of the mean oxidation number of chromium from 3.12 to 5.65. The volume of oxygen liberated by the reaction between 100 mg. of catalyst and 5.0 cc. of 30 % hydrogen peroxide (Edogawa Kagaku, Analytical Reagent) at 25°C was followed as a function of time for about ten minutes. The curves were found to be nearly straight. The catalytic activity represented by the volume of liberated oxygen per minute per g. of chromium is plotted against the concentration of chromium in Fig. 1. The curves bear a striking resemblance to those of the mean oxidation number as a function of chromium concentration shown in Fig. 1 of the previous paper. The above-mentioned activity is divided by the mean oxidation number of chromium and plotted against the concentration of chromium in Fig. 2.

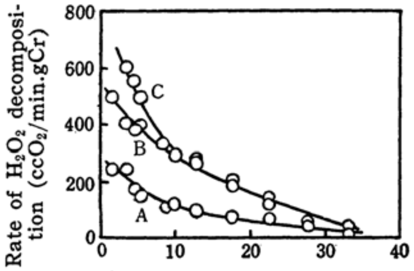

Fig. 1. Catalytic activity of oxidized chromia-alumina as a function of chromium concentration.
A; oxidized at 250°C, B; at 350°C, C; at 450°C.

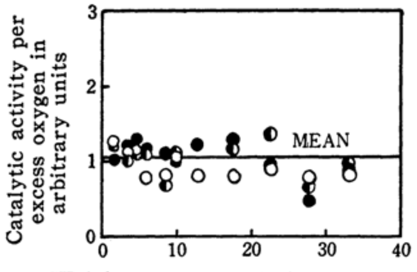

Fig. 2. Catalytic activity per excess oxygen in oxidized chromia-alumina as a function of chromium concentration.
○; oxidized at 250°C, ◑; at 350°C, ●; at 450°C.

It appears that the catalytic activity for a given amount of excess oxygen is nearly

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[1] Y. Matsunaga, This Bulletin, **30**, 868 (1957).

[2] S. E. Voltz and S. W. Weller, *J. Am. Chem. Soc.*, **76**, 1586 (1954).

constant regardless of the mean oxidation number of chromium over the whole concentration range of chromium. In some of our catalyst samples the mean oxidation number of chromium exceeds plus five; therefore, we can conclude that the activity is largely due to the chromic anhydride formed on the surface of these catalysts. This conclusion is not only consistent with the suggestion given by Voltz and Weller, but also clarifies more definitely the nature of the surface of these catalysts.

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