## Oxidation of Propylene over Cu(II)-Y Molecular Sieve under High Steam Concentration<sup>1)</sup>

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In a previous paper,2) it was reported that acrolein was formed from propylene over the Y molecular sieve ion-exchanged with cupric ion (Cu(II)-Y) in the presence of steam. As the molecular sieve is highly acidic, it is expected to play a bifunctional catalytic role for the synthesis of acetone from propylene through hydration and dehydrogenation under adequate conditions.

In the present study, reactions of propylene over this catalyst under high steam concentration was carried out using a flow reactor with a fixed catalyst bed. Feed and product compositions were analyzed gas-chromatography. The procedures similar to those reported by Ogasawara et al.3)

The results obtained in the absence of oxygen (Fig. 1) indicate that isopropanol and acetone can be formed in place of another. This suggests that acetone is formed from propylene via hydration and dehydrogenation. The maximum yield of acetone was 1.3% at 315°C, where the yield is defined by (product moles)/(propylene fed).

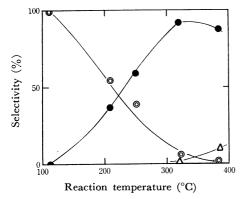


Fig. 1. Selectivity of products over Cu(II)-Y without oxygen. Cu(II)-Y: 4 g. Reactant gas composition, C<sub>3</sub>H<sub>6</sub>:H<sub>2</sub>O=1:20. lacktriangle: acetone, lacktriangle: isopropanol, lacktriangle: ethylene.

The results in the presence of oxygen are shown in Fig. 2. The main products other than carbon dioxide were isopropanol below 200°C, acetaldehyde at around 250°C and acetone above 450°C. It should be mentioned that acrolein was the main product under low steam concentration.2) The maximum yields of acetal-

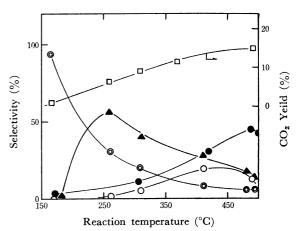


Fig. 2. Selectivity of propylene oxidation over Cu(II)-Y in the presence of oxygen (selectivity is based on products excluding carbon dioxide). Cu(II)-Y: 2.7 g. Reactant gas composition, C<sub>3</sub>H<sub>6</sub>:O<sub>2</sub>:H<sub>2</sub>O =1:1:20.

 $\square$ : CO<sub>2</sub> yield,  $\blacksquare$ : acetone,  $\square$ : isopropanol,  $\blacktriangle$ : acetaldehyde, O: acrolein.

dehyde and acetone were 1.0 and 0.7%, respectively. Moro-oka et al.4) and Ogasawara et al.3) reported selective oxidation of propylene into acetone on molybdena catalysts. Backer and Carrick reported the oxidative cleavage of olefinic double bond on chromia catalyst.<sup>5)</sup> From their results and ours, formation routes for acrolein, acetaldehyde, and acetone can be described as follows:

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<sup>2)</sup> I. Mochida, S. Hayata, A. Kato, and T. Seiyama, J. Catalysis, 19, 405 (1970).

<sup>3)</sup> S. Ogasawara, S. Takahashi, A. Fukai, and Y. Nakada, Kogyo Kagaku Zasshi, 72, 2244 (1969); S. Ogasawara, Y. Nakata, Y. Iwata, and H. Sato, ibid., 73, 509 (1970); S. Ogasawara, H. Sato, and Y. Iwata, ibid., 73, 509 (1970).

Y. Moro-oka, S. Tan, and A. Ozaki, J. Catalysis, 12, 291 (1968); 17, 125 (1970); S. Tan, Y. Moro-oka, and A. Ozaki, ibid., 17, 132 (1970).

<sup>5)</sup> L. M. Backer and W. L. Carrick, J. Org. Chem., 33, 616 (1968).