

*Detection of Atomic Oxygen in the Decomposition Products of Nitrous Oxide by the Platinum Catalyst at Low Pressures*

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Nitrous oxide is decomposed by platinum catalyst into oxygen and nitrogen. It is generally accepted that the first step of this reaction is  $\text{N}_2\text{O} \rightarrow \text{N}_2 + \text{O}$ ; and that the nitrogen is given off from the surface, while the oxygen atom remains adsorbed. The authors have investigated to find whether this oxygen atom is given off in the atomic state into the gas phase at low pressures.

The main part of the apparatus is shown in Fig. 1.

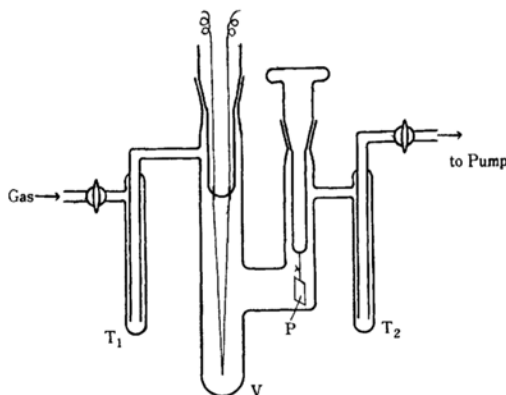
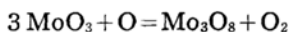


Fig. 1.

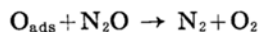
In the reaction vessel V, a platinum ribbon ( $0.024 \times 0.28 \times 363$  mm.) is stretched, which can be heated by electric current. Atomic oxygen is detected by the change of color of molybdenum trioxide from pale yellow to deep blue according to the following equation<sup>1)</sup>:



Molybdenum trioxide is deposited on a glass plate P, which is hung in the side tube of the reaction vessel. All the apparatus can be evacuated by a diffusion pump through a trap cooled by dry ice.

After decomposing nitrous oxide, it was found that atomic oxygen is given off from

the platinum surface heated in vacuo for a long time<sup>2)</sup>. Therefore, the following preliminary treatment of the platinum ribbon is necessary before every experiment. The platinum ribbon is heated in hydrogen first, and then in vacuo, to a high temperature. Subsequently oxygen is admitted, and the ribbon is heated again. Finally the ribbon is heated once more in vacuo to  $1400^\circ\text{C}$  for an hour. After this treatment, the platinum ribbon does not give off atomic oxygen. Now, nitrous oxide is conducted from the reservoir to the pump through the reaction vessel, the pressure in the reaction vessel being kept at  $1 \times 10^{-3} \sim 5 \times 10^{-4}$  mmHg. When the platinum ribbon is heated to  $1400^\circ\text{C}$ , molybdenum trioxide changes its color distinctly from pale yellow to deep blue within 30 min. From this experiment it is certain that atomic oxygen is given off when nitrous oxide is decomposed by the platinum catalyst at low pressures. When the pressure of nitrous oxide is higher ( $0.1 \sim 0.03$  mmHg), no atomic oxygen is detected in a similar experiment. In the latter experiment, oxygen atoms given off from the platinum surface may recombine to form molecular oxygen before reaching the detector of atomic oxygen. But it is also probable that nitrous oxide molecules collide from the gas phase to the adsorbed oxygen atoms very frequently when the pressure of nitrous oxide is higher, and that consequently adsorbed oxygen atoms are given off as molecular oxygen according to the following reaction:



In order to decide which mechanism is true, further investigations are necessary.

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2) A detailed report will be published in the near future.

1) W. H. Rodebush and W. A. Nichols, *J. Am. Chem. Soc.*, **52**, 3864 (1930).