

OXIDATION OF IRON IN NITRIC OXIDE

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Oxidation of iron plates in nitric oxide was examined. The oxidation rate was higher than that in oxygen in a certain temperature range, 450-580°C, however, it had a minimum at 550°C in regard to its temperature dependencies. The scales formed in nitric oxide was found to be consisted of only Fe_3O_4 .

We have previously reported^{1,2)} that nickel was oxidized more rapidly by nitric oxide than that by oxygen, while copper was oxidized more rapidly by oxygen than that by nitric oxide, moreover, the oxidation of these metals in nitric oxide obeyed the linear rate law. In this study, we examined the oxidation behaviors of iron plates in nitric oxide in comparison with that in oxygen.

The oxidation process was measured with a Gulbransen-type micro-balance settled in a high vacuum apparatus. Nitric oxide of a high purity in a glass cylinder from the Takachiho Co. were used without further purification. The oxygen was prepared by bulb-to-bulb distillation from a commercial cylinder at a temperature of liquid nitrogen. Iron specimens were 0.1 mm in thickness and 2.0 cm^2 in total surface area. They were vacuum-annealed at 800°C for 2 hr, and then electropolished in a solution of $\text{HClO}_4\text{-CH}_3\text{COOH-H}_2\text{O}$.

Figure 1 shows the oxidation curves of iron plates in 10 Torr of nitric oxide at various temperatures. The oxidation was not found to obey any simple oxidation law, such as the linear, parabolic, logarithm or anti-logarithm rate law etc. Temperature dependencies on the oxidation were shown in Fig.2. In the figure, the weight gain at 60 min after the beginning of the oxidation was plotted against the oxidation temperature. The open circles signify the values obtained by the oxidation in nitric oxide and the solid circles signify that in oxygen. As seen in the figure, the dependencies of the amount of the weight gain on the reaction

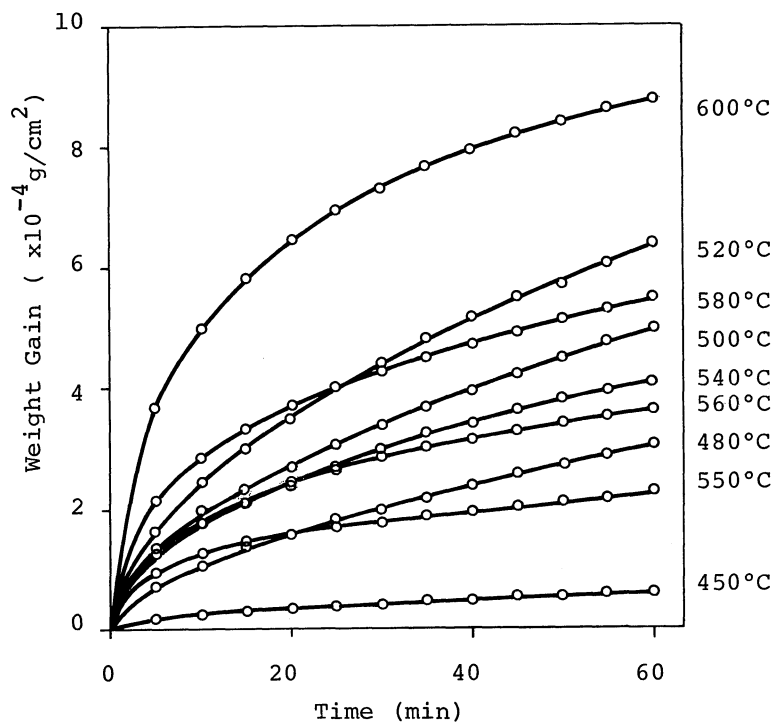


Fig. 1. Oxidation of iron at 10 Torr of nitric oxide at various temperatures.

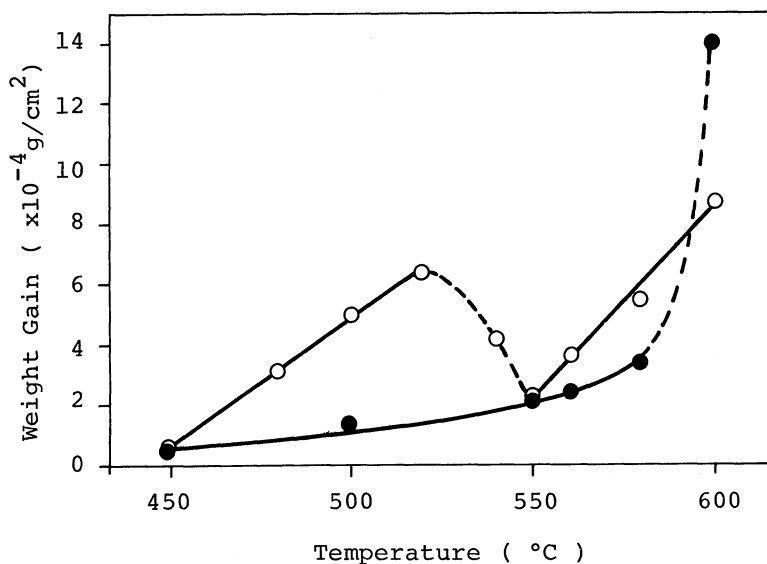


Fig. 2. Relations between the amount of oxidized and the oxidation temperature.

○: oxidation in nitric oxide (10 Torr, 60 min)
●: oxidation in oxygen (10 Torr, 60 min)

temperature were quite different between the case of the oxidation by oxygen and by nitric oxide. Particularly, in the case of the later, a minimum was found about 550°C. Then, the scales formed in nitric oxide were found to be consisted of only Fe_3O_4 by means of X-ray diffraction analysis, while the scales formed in oxygen were of Fe_3O_4 and Fe_2O_3 .

References

- 1). Y. Takasu, Y. Matsuda, S. Maru, and N. Hayashi, *Nature*, **255**, 544 (1975).
- 2). Y. Takasu, Y. Matsuda, S. Maru, N. Hayashi, H. Yoneyama, and H. Tamura, *J. Phys. Chem.*, (in press).

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