

HCl Gas Removal from a Vapor Phase using Magnesium Oxide Having High Activity

Michiko Kitagawa¹, Nana Ishida², Erika Yoshino², and Hiromi Matsushashi*²

¹RIKEN, Wako, Japan

²Hokkaido University of Education, Hakodate, Japan

*E-mail: matsushashi.hiromi@h.hokkyodai.ac.jp

Magnesium Oxide is well known as a representative solid base. Magnesium oxide is commonly prepared by a thermal decomposition of hydroxide or carbonate at an elevated temperature. We reported that the MgO prepared by short time thermal decomposition of Mg(OH)₂ has higher activity for a base-catalyzed reaction than that prepared by conventional procedures [1]. In addition, it was reported that MgO having larger surface area and higher activity was prepared from oxalate [2]. Magnesium oxide prepared by thermal decomposition of the oxalate had particularly high base catalytic activity. It was expected that MgO prepared from oxalate shows higher ability for the removal of HCl gas in vapor phase. The purpose of this study is to clarify the ability difference of the MgO samples prepared from hydroxide and oxalate to remove HCl.

Magnesium hydroxide was prepared as follows. Pure MgO (Merck) was placed in a beaker, and heated for 1 hour in distilled water to obtain Mg(OH)₂. The obtained sample was dried at 373 K for 12 hours.

Thermal decomposition of Mg(OH)₂ into MgO was carried out in a muffle furnace. The hydroxide was placed in the furnace kept at 673 K, and then the sample was taken out from the furnace after 20 min. Decomposition of MgC₂O₄·2H₂O into MgO was carried out in a muffle furnace at 773 K for 3 hours. The decomposition oxalate into oxide was not complete in the treatment conditions same as that of hydroxide decomposition.

Both samples were set in the gas flow system immediately after the cooling down to room temperature under atmosphere.

HCl removal was carried out as follows. HCl removal from a vapor phase was

performed at room temperature. After MgO was set in a reactor, HCl and dried air were flowed. Chemical species in effluent gas were analyzed by mass spectrometer. The surface area was measured by BET method. The sample was treated at 573 K for 2 h in a vacuum before the measurement.

Figure shows time course of HCl (*m/z* 36) concentration in gas phase measured using mass spectrometer. The concentration of HCl decreased immediately after the HCl feed in both samples. The HCl signal was kept in a low concentration level for a long time, when MgO prepared from MgC₂O₄·2H₂O was applied. The periods of low HCl concentration in two MgO samples were much different.

In this experiment, H₂O (*m/z* 18) signal was observed with the removal of HCl. It indicates that chemical reaction of HCl and MgO took place. These were converted into MgCl₂ and H₂O. A part of H₂O formed was trapped as crystallization water in MgCl₂ bulk.

The surface areas of MgO prepared by the thermal decomposition from MgC₂O₄·2H₂O and Mg(OH)₂ were 235 m² g⁻¹ and 247 m² g⁻¹ respectively. These values were very similar. However, the ability for HCl removal was much different. There was no relation between the surface area and ability for HCl removal.

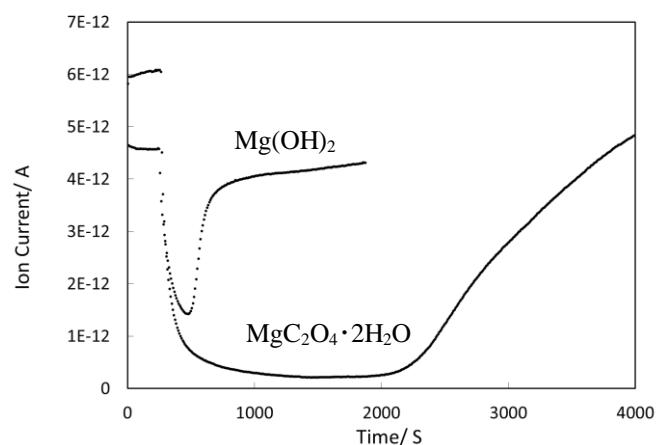


Figure. Time course of HCl (*m/z* 36).

REFERENCES

- [1] M. Kitagawa, S. Misu, J. Ichikawa, H. Matsushashi, Res. Chem. Intermed. 41, (2015) 9463.
- [2] J. K. Bartley, C.Xu, R.Lloyd, D. I. Enache, D. W. Knight, G. J. Hutchings, Appl. Catal. B, 128, (2012) 31.