

Thermal Decomposition Behaviors of Hexafluoroethane (C₂F₆) Using Zeolite/Calcium Oxide Mixtures

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Abstract : HFC and PFC gases have been commonly and widely used as refrigerant of air conditioner and as etching agent of semiconductor manufacturing process, because of their higher heat of vaporization and chemical stability. On the other hand, HFCs and PFCs gases have the high global warming effect on the earth. Therefore, we have to be decomposed these gases emitted from chemical apparatus like as refrigerator. Until now, disposal of these gases were carried out by using combustion method like as Rotary kiln treatment mainly. However, this treatment needs extremely high temperature over 1000 °C. In the recent year, in order to reduce the energy consumption, a hydrolytic decomposition method using catalyst and plasma decomposition treatment have been attracted much attention as a new disposal treatment. However, the decomposition of fluorine-containing gases under the wet condition is not able to avoid the generation of hydrofluoric acid. Hydrofluoric acid is corrosive gas and it deteriorates catalysts in the decomposition process. Moreover, an additional process for the neutralization of hydrofluoric acid is also indispensable. In this study, the decomposition of C₂F₆ using zeolite and zeolite/CaO mixture as reactant was evaluated in the dry condition at 923 K. The effect of the chemical structure of zeolite on the decomposition reaction was confirmed by using H-Y, H-Beta, H-MOR and H-ZSM-5. The formation of CaF₂ in zeolite/CaO mixtures after the decomposition reaction was confirmed by XRD measurements. The decomposition of C₂F₆ using zeolite as reactant showed the closely similar behaviors regardless the type of zeolite (MOR, Y, ZSM-5, Beta type). There was no difference of XRD patterns of each zeolite before and after reaction. On the other hand, the difference in the C₂F₆ decomposition for each zeolite/CaO mixtures was observed. These results suggested that the rate-determining process for the C₂F₆ decomposition on zeolite alone is the removal of fluorine from reactive site. In other words, the C₂F₆ decomposition for the zeolite/CaO improved compared with that for the zeolite alone by the removal of the fluorite from reactive site. HMOR/CaO showed 100% of the decomposition for 3.5 h and significantly improved from zeolite alone. On the other hand, Y type zeolite showed no improvement, that is, the almost same value of Y type zeolite alone. The descending order of C₂F₆ decomposition was MOR, ZSM-5, beta and Y type zeolite. This order is similar to the acid strength characterized by NH₃-TPD. Hence, it is considered that the C-F bond cleavage is closely related to the acid strength.

Keywords : hexafluoroethane, zeolite, calcium oxide, decomposition

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