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Effect of Mn-Based Additive for Enhancing Stability of Cu-Based Oxygen Carriers for CLC Process

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Extended Abstract

Techniques for reducing greenhouse gases have been developed variously as research to suppress global warming. As a technique for collecting carbon dioxide, pre-combustion carbon dioxide capture, carbon dioxide capture after combustion, and carbon dioxide capture during combustion are being developed. Pure oxygen combustion technology and chemical looping combustion technology have attracting attention as carbon dioxide capture technology during combustion. Since these two combustion technologies exhaust only carbon dioxide and water during the combustion of fuel, the cost for separating carbon dioxide in exhaust gas is relatively low. The chemical looping combustion technology is a more economical combustion technology than pure oxygen combustion technology that uses pure oxygen as a metal oxide as an oxygen carrier. In this study, metal oxides used as oxygen carriers in chemical looping combustion were developed. The metal oxide, which is the oxygen transfer, circulates between the fuel reactor to the air reactor and supplies oxygen in the fuel reactor. Both reactors operate at high temperatures above 850^{o}C and recover heat of reaction to produce electricity and heat. Oxygen carriers must have high thermal stability, high oxygen capacity and transfer rate, and should have high attrition resistance because they have used in a circulating fluidized bed reactor.

Nickel-based particles have been studied extensively as oxygen-transferring particles that can be used in chemical looping combustion. Recently, researches for developing low-cost oxygen-transferring particles have been actively conducted. In this study, the oxygen transfer capacity of Cu-based oxygen transfer particles was investigated and various additives were mixed to improve the performance of these oxygen transfer particles. Cu exhibits high oxygen transfer rates, but they cannot be used for chemical looping combustion under high temperature conditions due to their low thermal stability. Among the mixed metal oxides mixed with various additives, it was confirmed that Mn is an additive for enhancing stability at high temperature of Cu. Therefore, the changes of oxygen transfer capacity and oxygen transfer rate were investigated by controlling the mixing ratio of Cu/Mn. In this study, Mn was mixed to improve the thermal stability of Cu component and the effect of these was investigated. Crystal structure of Cu-based mixed metal oxides and their stability under the temperature condition, which the spinel structure is synthesized, was investigated. As a result, the spinel structure was well maintained in the oxidation-reduction cyclic-repeated tests and the migration of Cu was not severe. It was also confirmed to have high durability. It was concluded that Mn inhibits the migration of Cu because it forms spinel with Cu.

References

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