Kinetics of Ni-based oxygen carrier with MgO contents for chemical looping combustion (CLC)

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Carbon capture and storage (CCS) is one of the major options to reduce the CO_2 emission from large stationary sources like a power plants. Among several carbon capture technologies for power plants, chemical looping combustion (CLC) has attracted much attention due to the expectation of a higher thermal efficiency and a lower cost of electricity [1]. A CLC process consists of a fuel reactor and an air reactor which are interconnected fluidized bed reactor (see Fig. 1). Oxygen carrier is reduced by fuel gas in a fuel reactor. Reduced oxygen carrier is transported to air reactor and oxidized by air and circulated between the two reactors repeatedly. In the CLC system, CO_2 of high concentration can be obtained, in principle, by removing H_2O in the gas stream emitted from the fuel reactor.

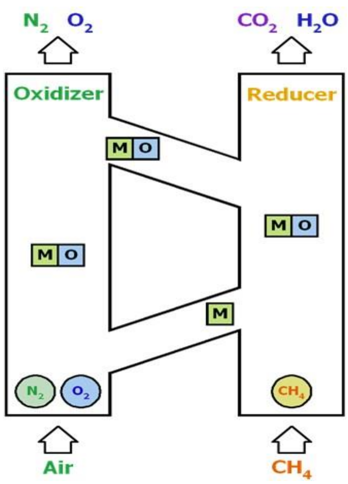

Fig. 1 Schematic of chemical looping combustion system

The reduction reaction rate of an oxygen carrier is one of the most important properties in the CLC system as it dictates the solids circulation flux between fuel reactor and air reactor, and the amount of bed materials required in the system [2].

In this study, we have conducted the experiment and interpreted reduction and oxidation reaction characteristics via observing weight change of Ni-based oxygen carrier with MgO contents (4.2, 8.4 wt%) using the TGA with varying gas concentration and temperature. We also adapted a basic kinetic model (JMA model) to interpret the oxygen transfer capacity and oxygen transfer rate of Ni-based oxygen carrier based on TGA test results.

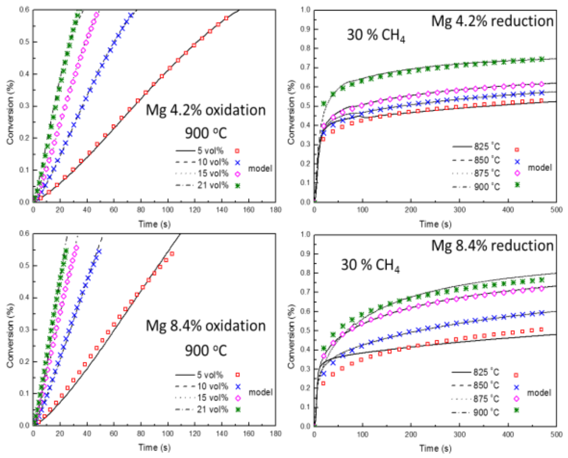

Fig. 2 Effects of gas concentration(oxidation) and reaction temperature(reduction) and curve fitting of JMA model for Ni-based oxygen carrier with MgO contents

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