Water splitting and syngas oxidation of metal oxides for chemical-looping hydrogen production

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Hydrogen production from water is one of the most important long-term goals for future energy resources. Water splitting with reduction and oxidation of metal oxide, one of hydrogen production methods, does not produce harmful pollutants so that it is an environment friendly process. This water splitting system consists of reduction of metal oxide and oxidation by water. Several reduction gases should be considered for heat supply since the heat for direct reduction of metal oxide is highly endothermic reaction. In the present study, metal oxides based on Ni, Fe, Cu and Mn have been evaluated for "chemical-looping hydrogen production (CLH)" by oxidizing with water and reducing with syngas in thermogravimetric analyzer (TGA). Properties of the particles were analyzed by SEM, XRD, and N_2-BET. The reactivity increases with increasing temperature, and oxides of Cu and Mn are better than those of Ni and Fe for CLH. Nickel oxide has low water splitting ability and both reduction and oxidation reactions of iron oxide are slower than those of Cu and Mn. The oxidation and reduction reactions of metal oxides for water splitting with syngas were characterized by the kinetic equations based on the gas-solid reaction model.