Kinetics and property change of oxygen carriers for chemical-looping combustion

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For the chemical-looping combustion (CLC), an alternative gas combustion by redox of metal oxide as oxygen carrier, NiO, Fe_2O_3, Mn_2O_3, and CuO for oxygen carriers supported on bentonite were selected as looping materials. The reactivities of oxygen carrier particles were characterized by the kinetic equations based on the solid-state reaction models, namely, diffusion-controlled, phase-boundary-controlled and Avrami-Erofe'ev phase change models, by Sharp and Hancock method. The properties of oxygen carrier particles before and after reaction were investigated by SEM, XRD and Ar-BET to prove reaction mechanisms of oxygen carriers. The surface area and pore volume are increased in the range of 0.06-1.07 m^2/g and 0.2-1.0 mm^3/g before and after reduction of each particle, respectively. The phase-boundary-controlled reaction model is found to be represented well for each reaction of most of oxygen carriers. The activation energies and pre-exponential factors were determined from Arrhenius plot, respectively.