Reaction kinetics of oxygen carriers supported on bentonite for chemical-looping combustion

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The chemical-looping combustion (CLC), an alternative combustion of gas fuel, has the advantage of no energy loss for the separation of CO_2 without nitrogen oxide formation. For the CLC process, readily available metal oxides, NiO, Fe_2O_3, Mn_2O_3 and CuO for oxygen carriers supported on bentonite were selected as looping materials. The reactivity of oxygen carrier particles was determined in a thermal gravimetric analyzer (TGA) at alternating reduction and oxidation conditions at 923-1123 K. Methane was used for the fuel gas and air was injected at oxidation condition. The reactivities of metal oxides were characterized by the kinetic equations based on the gas-solid reaction models (shrinking core, uniform reaction, and modified volumetric models), and the obtained conversion data is well presenting by the reaction models with correlation coefficient above 0.97 for almost cases, especially, shrinking core and modified volumetric models. The activation energies and pre-exponential factors were determined from Arrhenius plot, respectively.