Reaction Kinetics of CO_2 Gasification for Coal Char at Elevated Pressure by Direct Measurement of Particle Temperature

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A pressurized heated-wire reactor that can provide experimental conditions up to 50 atm and 1750 K was developed to evaluate the intrinsic reaction kinetics of CO2 gasification for coal char at elevated pressure using a synchronized experimental method. This synchronization system consists of a thermocouple wire for both heating and direct measurement of the particle temperature and a photodetector sensor for determining ignition/burnout points by measuring the intensity of the luminous emission from the reaction particle. The kinetics of CO2 gasification is determined from an intrinsic reaction rate model that considers external/internal carbon dioxide diffusion at elevated temperature and pressure. The carbon dioxide diffusion model was formulated to quantify the effects of external/internal diffusion processes. The results showed that the reaction rate constant occurred in zone II, where the pore structure strongly influences the rate at which gaseous reactants are transported to the internal surfaces of the char. In addition, intrinsic reaction kinetics from CO2 char gasification data obtained at high temperatures and pressures were obtained by considering the external and internal carbon dioxide diffusion.