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Study on the reduction of hematite by hydrogen-rich gas: multi-step Reaction kinetics and Characterization

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Hydrogen-rich ironmaking technology offers rapid reaction rates and substantial emission reductions, with the optimal hydrogen enrichment ratio being crucial for the reduction rate and degree of hematite. This study employed a thermogravimetric analyzer to explore the reduction characteristics and kinetic parameters of hematite particles in a hydrogen-rich environment across 650-900 ℃. The reduction process was divided into two stages within the intervals of 650-750 ℃ and 800-900 ℃, influenced by the migration rate of lattice oxygen within iron oxides, with reduction degrees of 0.23 and 0.33 demarcating each stage. Analysis of the physical phase composition at key points and the proportion of constituents indicated that the distinct reduction steps of iron oxides in a hydrogen-rich atmosphere occur nearly simultaneously. Using model-free and Johnson-Mehl-Avrami methods, we found that the peak in activation energy corresponds to the reduction degree threshold, marking the transition to the predominant reduction phase from FeO to Fe. Additionally, the two-dimensional nucleation growth model effectively describes the reduction of hematite in both stages.

Speaker Country

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