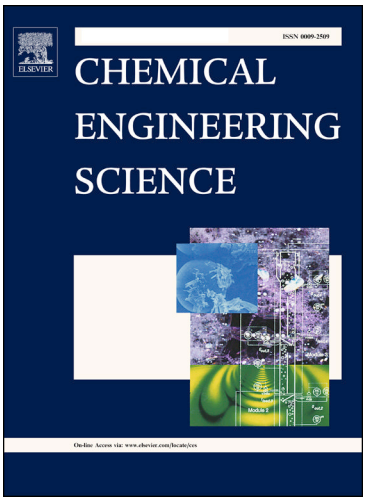

Heterogeneous Oxidation of Zinc Vapor by Steam and Mixtures of Steam and Carbon Dioxide

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Heterogeneous Oxidation of Zinc Vapor by Steam and Mixtures of Steam and Carbon Dioxide

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ABSTRACT

The kinetics of the heterogeneous oxidation of zinc vapor by water vapor were measured in a tube flow reactor for temperatures from 800 to 1100 K, zinc vapor partial pressures up to 0.39 atm, and water vapor partial pressures up to 1.0 atm. The results extend the prior data for oxidation of zinc by water vapor from zinc partial pressures on the order of 0.01 atm to higher values appropriate for fuel production via the Zn/ZnO thermochemical cycle. Measured oxidation rates span 10^{-7} to 10^{-5} mol cm^{-2} s^{-1}. A second order, reversible reaction rate expression $r'' = k_{\mathrm{Zn\text{-}H_2O}} \left(p_{\mathrm{Zn(g)}} p_{\mathrm{H_2O}} - \frac{p_{\mathrm{H_2}}}{K_{\mathrm{eq}}} \right)$ is developed from regression of the data and a numerical model of advective and diffusive mass transfer. The kinetic parameter $k_{\mathrm{Zn\text{-}H_2O}}$ is a non-monotonic function of temperature with a negative activation energy for temperatures between 800 and 1050 K, consistent with prior studies. In a second set of experiments, the rate of the heterogeneous oxidation of

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