198d Instrinsic Global Kinetics of Rapid Nickel Oxalate Thermal Decomposition

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The global kinetics for the thermal decomposition of nickel oxalate within an aerosol flow reactor are studied by applying a one-dimensional particle phase model to the reactor. The particle velocity and axial temperature profiles are generated by the model. The solid precursor is 12 micron nickel oxalate particles. The particles are large enough in size for the gravitational force to cause slip between the particle and fluid phase, and the particles pass through the reactor slightly faster than the gas phase. Because of the high heating rates attainable in an aerosol flow reactor, rapid reaction is possible. Particle residence times for the kinetic study range from 2 – 6 seconds for reactor temperatures of 695 – 767 K. The model also incorporates the non-isothermal form of solid state decomposition kinetics. The model that best fits the experimental conversion data is the first order expression. This kinetic result is interpreted as instantaneous nucleation of product nickel followed by two-dimensional growth of these nuclei controlled by diffusion of the product carbon dioxide. The best fit Arrhenius rate parameters along with 95% joint confidence interval limits are a pre-exponential factor of $1.25x10^9 \pm 0.73x10^9$ s^{-1} and an activation energy of $1.30x10^5 \pm 0.20x10^4$ J/mol.