Public Abstract

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Department:Chemical Engineering

Degree:MS

Title:DEVELOPMENT OF A COMBINED DILATOMETER AND MASS SPECTROMETER SYSTEM FOR STUDYING GAS PHASE CHEMISTRY AND KINETICS DURING SINTERING

A combined dilatometry mass spectrometry system (CDMS) is developed in order to monitor the gas phase during the processing of ceramic materials. The CDMS is then used in the analysis of strontium titanate. Two gas phase species are identified based on isotope ratios, cracking patterns, and comparisons to the decomposition of model compounds; as carbon dioxide and sulfur dioxide. Based on the comparison of the primary peak sizes from the strontium titanate sample to the decomposition of the model compounds, these two gases can account for between 60 to 200% of the observed weight loss. The range is this large because it is unclear whether the carbon and sulfur reacted with oxygen from the solid sample, or with trace oxygen in the atmosphere.

The model-free technique for determining the apparent activation energy of this process proposed by Su and Johnson is modified using an approximation developed by Lee and Beck. The new equations are compared to numeric integration to find the activation energy for simulated data. All equations are proven to be highly accurate, two of them more so than numeric integration when noise is present in the data. Additionally, if an equation for the mechanism is known, the approximation can be substituted for the integral so that the full equation can be mathematically manipulated to facilitate analysis of the assumed mechanism.