Characteristics of n-heptane and toluene weak flames in a micro flow reactor with a controlled temperature profile

Abstract

n-Heptane and toluene, which are major components of gasoline surrogate, were applied to a micro flow reactor with a controlled temperature profile. Their ignition processes were examined by investigating weak flames observed in the low flow velocity condition in the reactor. Weak flame images were captured using n-heptane/air, toluene/air, and blended fuel (n-heptane + toluene)/air mixtures all at the stoichiometry. Results showed that hot flame shifted significantly to a higher temperature range with the increase of toluene fraction in the fuel, which indicates ignition inhibition by toluene addition to n-heptane. Furthermore, the capability of the reactor to stationary observe the ignition process of toluene in low temperature range was demonstrated. Computation with the chemical kinetics of PRF + toluene reproduced the experimental results very well. Gas sampling analyses were done for weak flames of n-heptane, toluene, and their blended fuel. Comparison between measured and computational mole fraction profiles of major species showed a good qualitative agreement except for the case of toluene/air. Weak flames for n-heptane and n-heptane + toluene blended fuel at P=5 atm were observed to examine the effect of toluene addition to n-heptane on ignition process at elevated pressure. Low temperature reaction which increases its reactivity at elevated pressure was weakened and the main reaction process, hot flame showed obvious ignition inhibition by the toluene addition.

Keywords

microcombustion; weak flame; n-heptane; toluene; surrogate;