The High-Temperature Autoignition of 2,5-Dimethylfuran, a Potential Biofuel

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ABSTRACT

The autoignition of 2,5-dimethylfuran/O_2/Ar mixtures was studied in a low-pressure shock tube in the temperature range from 1272 to 2072 K, at pressures near 1 bar and 4 bar, for equivalence ratios of 0.5, 1.0, and 1.5, and at 2,5-dimethylfuran (DMF) molar fractions of 0.25%, 0.5%, and 1.0%. Ignition times were determined by OH* emission and pressure measurements made along the driven section of the shock tube. The observed ignition delay time overall activation energy remains constant over the studied temperature range at approximately 40 kcal/mol and the dependence of the ignition delay times on the concentrations of DMF, O_2, and Ar was determined allowing for the formulation of a simple correlation for the ignition delay time including power-law dependence on the concentrations and an Arrhenius term for temperature dependence. Comparison of the ignition delay time data with those for other biofuel alternatives, ethanol and 1-butanol, show that the ignition delay times for DMF are longer than those for ethanol and 1-butanol at equivalent conditions by factors ranging from two to ten over the range of temperatures studied. Additionally, ignition delay times for DMF are similar to those for the high-octane primary reference fuel for gasoline, iso-octane, perhaps indicating that DMF could be an appropriate knock-inhibiting oxygenated additive for gasoline or a stand-alone high-octane fuel for spark ignition engines. To the author's knowledge, the ignition delay time measurements presented here for DMF are the first such measurements for this potential biofuel and should prove useful for the development and validation of kinetic mechanisms for the description of DMF oxidation.