Supercritical carbon dioxide power cycle is a revolutionary concept for zero-emission, high efficiency, and compact power generation. This concept has brought about new questions on the chemical kinetics of several small hydrocarbon fuels and the effects of carbon dioxide as the primary diluent on the different fuels. This dissertation presents work on the ignition delay times and several species time-histories of methane, ethylene and syngas over a range of conditions at elevated temperatures. All experiments were conducted behind reflected shockwaves using two different shock tubes. The ignition delay times were measured using a GaP photodetector to measure the emission of light. The species time-histories were measured using single laser spectroscopy. The effect of CO2 as a diluent on the fluid dynamics of the system were also examined using high-speed camera images. It was determined that the ignition delay times and fuel time-histories were able to be accurately predicted by mechanisms in the literature at high pressures, but the literature mechanisms were unable to predict the carbon monoxide time-histories beyond qualitative trends for the various fuels. It was also determined that the carbon monoxide had a strong effect on the fluid dynamics of the experiments resulting in a significantly smaller chemical reaction zone. Experiments were also performed to examine the effects of water as a diluent with a ratio up to 66% of the total diluent on the ignition delay times. Using the experimental data, global kinetic mechanisms was created for methane and syngas to predict the ignition delay times and the carbon monoxide time-histories for pressures up to 300 atm.

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The public is welcome to attend.