Ethylene Combustion Studied Over a Wide Temperature Range in High Temperature Shock Waves

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Abstract

The initiation of ethylene combustion (at ϕ= 1 and 1.5) was studied over a wide range of temperatures (800-2273K) in shock waves. Ignition delay data showed the presence of 2 or 3 different chemically controlling regimes in the combustion.

Figure 1 shows the temperature dependence of the ignition delays of ethylene in N_2/O_2 mixtures. These were done on two different shock tubes under different conditions with a large amount of fuel (75 and 50% N_2 , O_2 and fuel making up the ϕ= 1 and 1.5).

At low temperatures (T~900-1000K) the time development of a combustion bubble was tracked via Schlieren techniques and was seen to grow slowly. It was formed away from the backwall of the shock tube at the lower temperatures, a result which was unexpected. Unburnt gas, between the bubble and endwall which was compressed and heated by the latter, exploded and gave rise to a strong combustion wave which travelled back through the partially burning gas. Emission measurements showed the presence of CH*, OH*, C_2* and a continuum emission attributed to CO_2^* flame bands. C_2* was found to be only important in richer mixtures. CH* was formed only ~µsecs ahead of the other diatomics. The spectra of CH* C_2* and OH * was tracked from the initial developing combustion bubble.

Further work and results on this system will be presented.

Figure 1