Hydrocarbon-Air Mixtures Ignition at High Pressures

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An auto-ignition of lean hydrocarbon-air mixtures (ϕ = 0.5) was studied in the shock tube behind the reflected shock wave at the wide pressure $P = 3$-500 atm and temperature range $T = 1200$-1750 K. A special heating system of our shock tube enables to study every hydrocarbon fuel mixtures at the high pressures. Reflected-shock pressure and temperature were calculated from the incident shock wave velocity using frozen chemistry one-dimensional shock wave theory. Ignition delay times were determined using emission at 306 nm OH($X^2\Pi \leftarrow A^2\Sigma^+$) and absorption at 3.3922 µm (component $F^{(2)}_1$ ($ν_j=1$) $\leftarrow F^{(2)}_2$($ν_j=0$) of $P(7)$ line of $ν_j$ mode of CH$_4$ molecule) diagnostics (Fig.1). The experimental data obtained were compared with the calculated by different mechanisms.

![Figure 1](image1.png)  
**Figure 1.** Absorption (CH$_4$) and emission (OH*) profiles behind reflected shock wave. 4.8% CH$_4$ + Air. $T_5 = 1265$ K, $P_5 = 173$ atm.

![Figure 2](image2.png)  
**Figure 2.** Ignition delay time for methane-air mixture in dependence on the pressure. Mixture 4.8% CH$_4$ + Air.
Thus, in the present work the data on the ignition delay times for methane-air mixtures were obtained in the wide range of parameters. GRIMech 3.0 mechanism [1] was validated in the wide range of parameters. It was shown that this mechanism is in a good agreement with the experimental data for lean mixtures and is able to describe the ignition delay time in the methane-air mixtures up to 450 atmospheres. This mechanism was expended for propane, butane and hexane – air mixtures on the basis of mechanism [2]. Good agreement between calculated and measured values in the wide pressure range was observed (Fig. 3, 4).

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References
