Detailed Kinetic Mechanisms for Combustion and Oxidation of Natural Gas

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Abstract

Recently, considerable attention has been paid to natural gas, because it burns more cleanly than other hydrocarbon. The aim of this study is to propose a detailed kinetic mechanism for combustion and oxidation of natural gas. The kinetic characterization of natural gas combustion represents an important and crucial role to correctly predict and describe the flame characteristics and stability. Even though, the accuracy of combustion schemes have been improved in recent years, nonetheless, no specific scheme with well predictability for unconventional combustions (oxy-fuel and flameless) has been introduced. With this goal, this work explores a detailed kinetic mechanism with predictive capabilities in a wide range of operating conditions (conventional and unconventional) oxidation and combustion of natural gas. Therefore, Modelling of methane combustion and oxidation in a wide range of operating conditions was carried out, but only highlighted result is shown here. The reported comparisons with the experimental data show a good agreement; however, there exists the possibility of further improvements.

Keywords

Detailed kinetic, Reaction mechanism, Natural gas, Combustion, Methane

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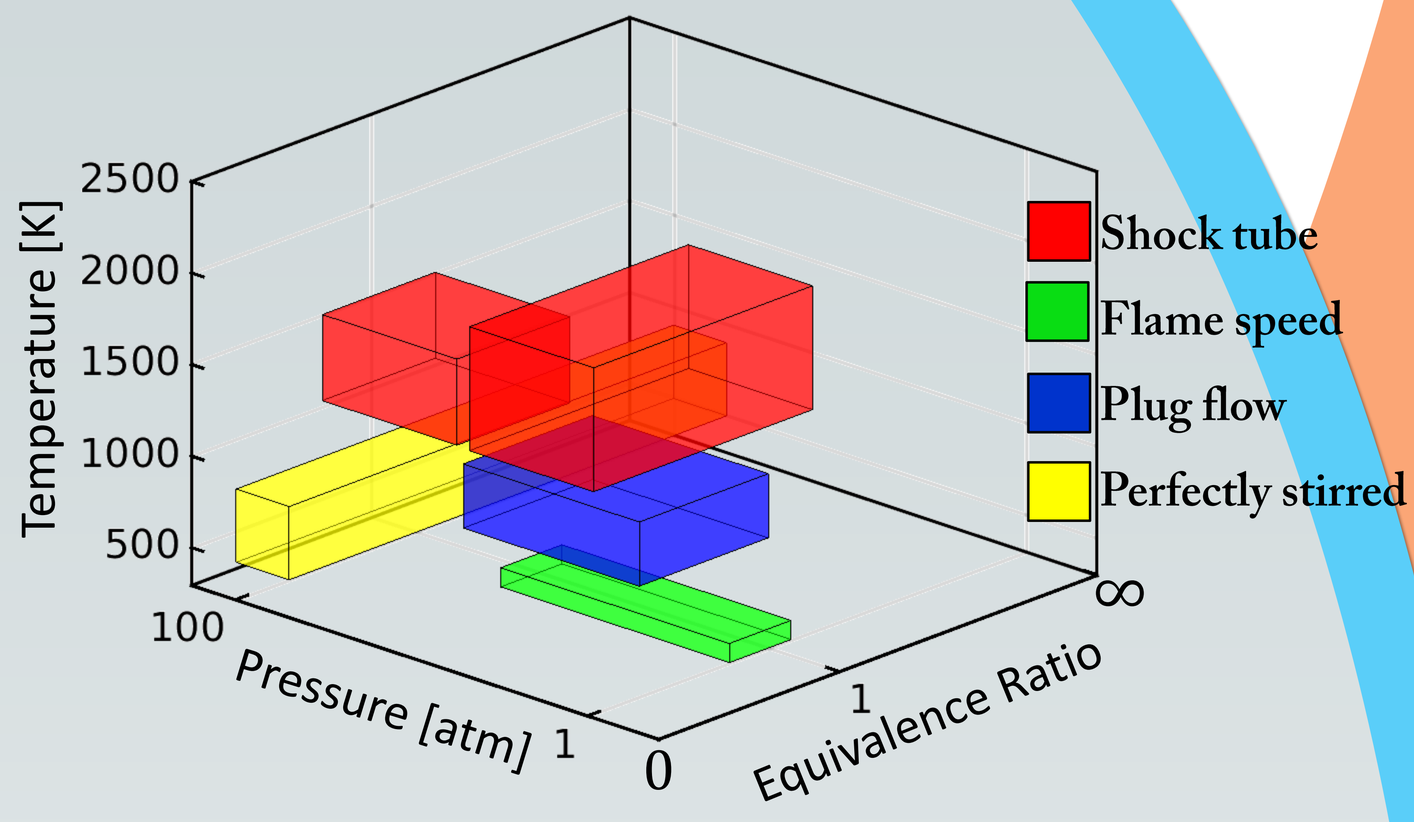
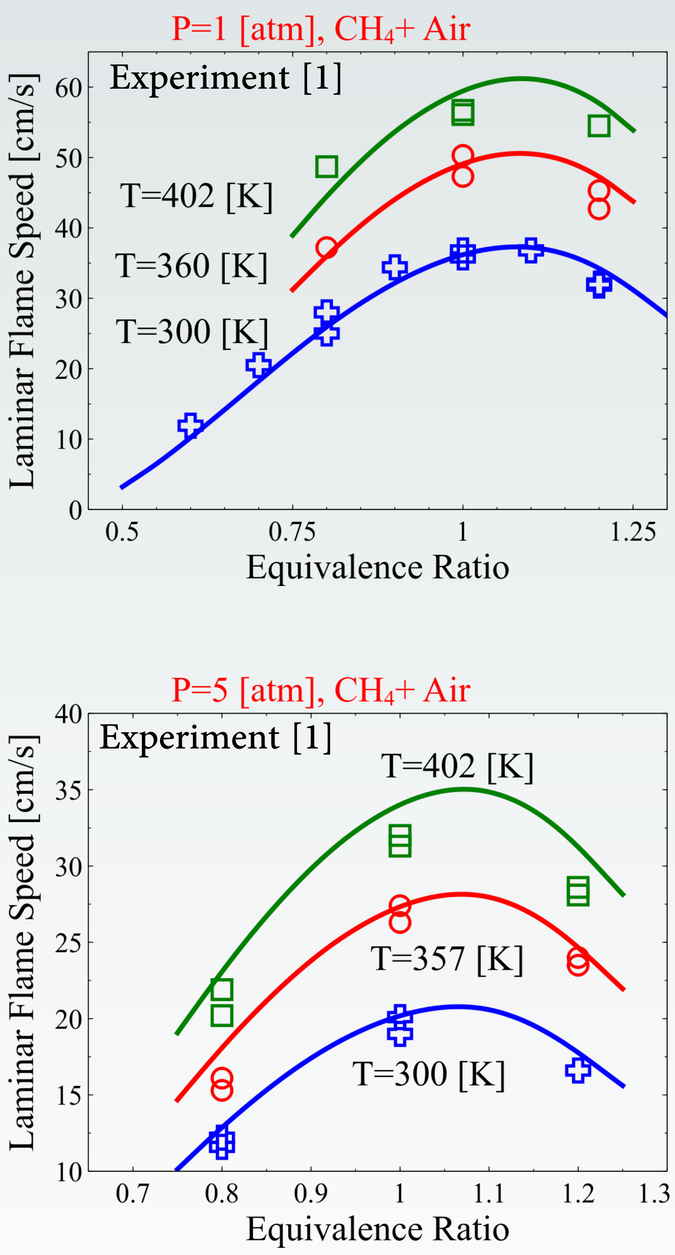
Objective

Recently, considerable attention has been paid to natural gas, because it burns more cleanly than other hydrocarbon. The aim of this study is to propose a detailed kinetic mechanism for combustion and oxidation of natural gas. The kinetic characterization of natural gas combustion represents an important and crucial role to correctly predict and describe the flame characteristics and stability. Even though the accuracy of combustion schemes have been improved in recent years, nonetheless, no specific scheme with well predictability for unconventional combustions (oxy-fuel and flameless) has been introduced. With this goal, this work explores a detailed kinetic mechanism with predictive capabilities in a wide range of operating conditions (conventional and unconventional) oxidation and combustion of natural gas.

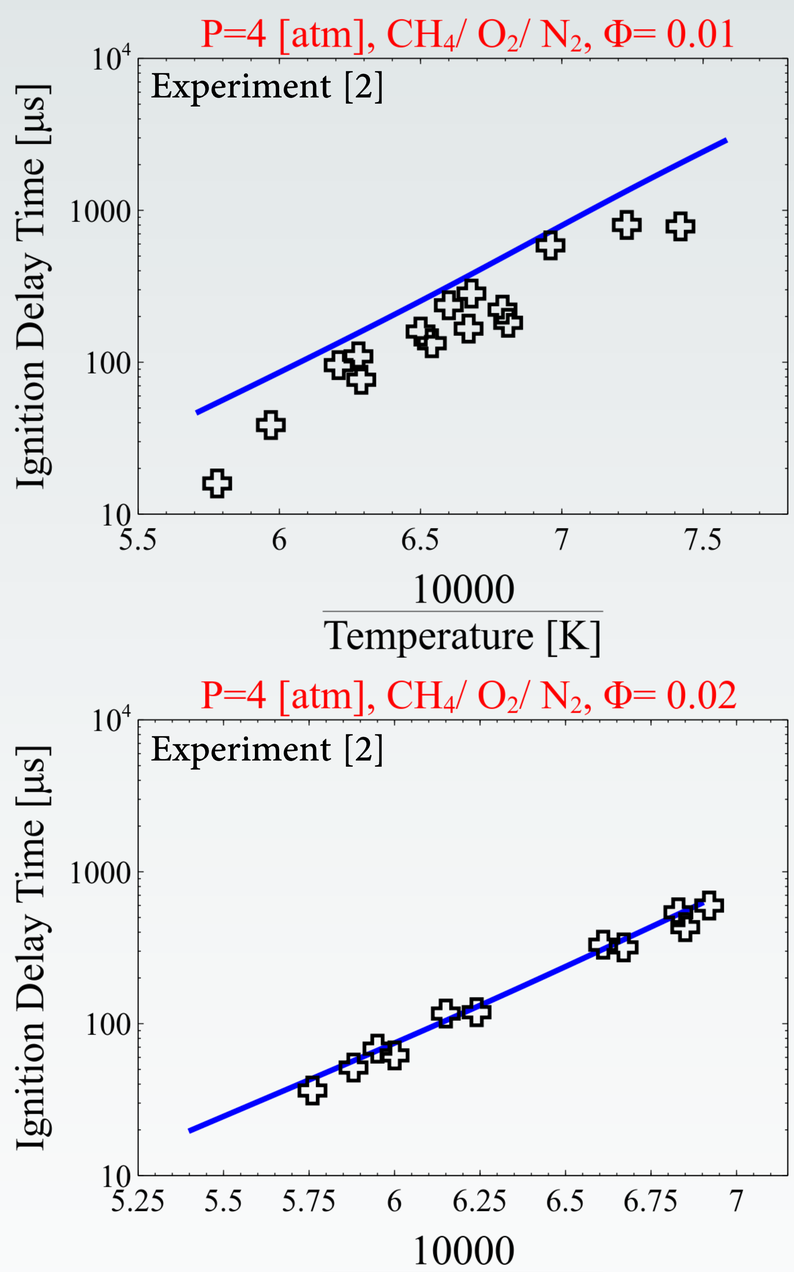
Range of Experimental Data



Laminar Flame Speed

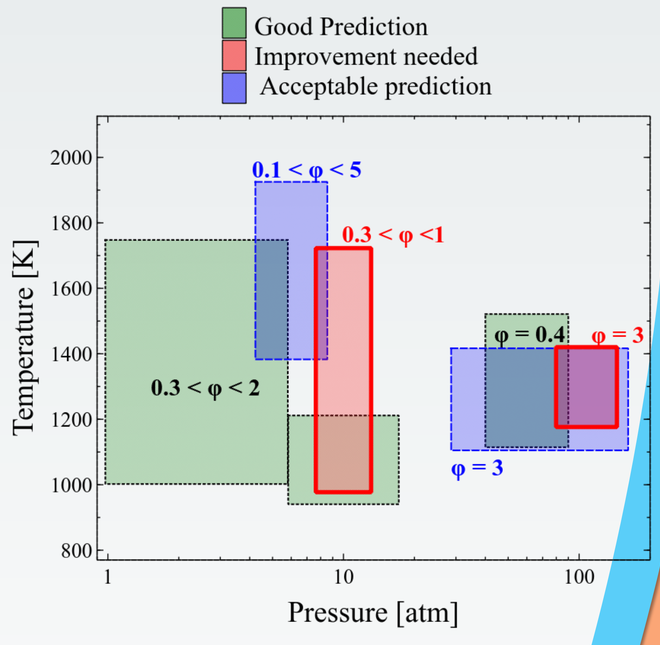


Ignition Delay time



Conclusion

Modeling of methane combustion and oxidation in a wide range of operating conditions was carried out, but only highlighted result is shown here. The reported comparisons with the experimental data show a good agreement; however, there exists the possibility of further improvements as points out in the below figure.



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References

[1] X. J. Gu, M. Z. Haq, M. Lawes, and R. Woolley, “Laminar burning velocity and markstein lengths of methane–air mixtures,” Combustion and flame, vol. 121, no. 1, pp. 41–58, 2000.

[2] C. Eubank, M. Rabinowitz, W. Gardiner, and R. Zellner, “Shock-initiated ignition of natural gas-air mixtures,” in Symposium (International) on Combustion, vol. 18, pp. 1767–1774, Elsevier, 1981.

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