Numerical study on the effect of CO addition on OH* chemiluminescence in laminar methane-oxygen inverse diffusion flames

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Non-intrusive chemiluminescence measurements has been recognized as a promising alternative for combustion diagnostics. As one of the major spontaneous emission in flames, OH* chemiluminescence, which can indicate the presence of chemical reacting, is widely used in the flame monitoring of combustion or gasification systems. In gasification process, CO is one of the main products which may have significant influence on flame emission and interfere with the spectral diagnostics in gasifier. For this reason, the effect of CO addition on OH* chemiluminescence in laminar methane-oxygen inverse diffusion flames was numerically investigated in this work. A detailed reaction mechanism was developed by combining GRI-Mech 3.0 and OH* chemiluminescence reaction mechanism of Bozkurt et al. to simulate the combustion process. A 2-D CFD simulation was carried out to determine the effect of CO addition on the flame structure and OH* chemiluminescence distribution, and an 1-D chemical kinetic calculation by CHEMKIN-PRO was performed to analysis the effect of CO addition on the production pathway of OH* chemiluminescence (as shown in Figure 1). The results show that the addition of CO in combustible mixture can diminish the ignition delay time and enhance the flame stability to intensify the combustion process of flame. Due to the decrease of H radicals in flame, the intensity of OH* chemiluminescence will decrease as the increase of CO mole fraction in fuel. When the fuel flow rate and the oxygen flow rate are fixed, the addition of CO in fuel will lead to the increase of oxygen-fuel equivalence ratio, so that the flame structure is changed significantly. In such a condition, the combustion characteristics of flame is mainly affected by the variation of oxygen-fuel equivalent ratio.

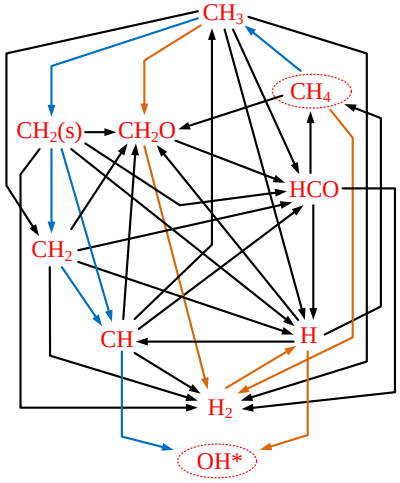

Figure 1. The production pathway of OH* chemiluminescence.

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