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Modeling of Plasma Assisted Combustion[1]

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Recently, many experimental study of plasma-assisted combustion has been done. However, numerous complex reactions in combustion of hydrocarbons are preventing from theoritical study for clarifying inside the plasma-assisted combustion, and the effect of plasma-assist is still not understood. Shinohara and Sasaki [1,2] have reported that the shortening of flame length by irradiating microwave without increase of gas temperature. And they also reported that the same phenomena would occur when applying dielectric barrier discharges to the flame using simple hydrocarbon, methane. It is suggested that these phenomena may result by the electron heating. To clarify this phenomena, electron behavior under microwave and DBD was examined. For the first step of DBD plasma-assisted combustion simulation, electron Monte Carlo simulation in methane, oxygen and argon mixture gas(0.05:0.14:0.81) [2] has been done. Electron swarm parameters are sampled and electron energy distribution function (EEDF)s are also determined. In the combustion, gas temperature is higher(>1700K), so reduced electric field E/N becomes relatively high(>10V/cm/Torr). The electrons are accelerated to around 14 eV. This result agree with the optical emission from argon obtained by the experiment of reference [2]. Dissociation frequency of methane and oxygens are obtained in high. This might be one of the effect of plasma-assist. And it is suggested that the electrons should be high enough to dissociate methane, but plasma is not needed.

[1] K. Shinohara et al, J. Phys. D:Appl. Phys., 42, 182008 (1-7) (2009).
[2] K. Sasaki, 64th Annual Gaseous Electronic Conference, 56, 15 CT3.00001(2011).

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