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Editorial: Advanced combustion technologies for low carbon emissions

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Editorial on the Research Topic
Advanced combustion technologies for low carbon emissions

CO_2 emissions from typical fossil fuel combustion process, such as heat supply, power generation, engine-driven vehicles, aircraft and rockets et al., lead to the global warming. Advanced combustion technologies for fossil fuels and carbon free fuels can reduce CO_2 emission during the practical applications. Hence, the combustion behaviors and the reactivity, flame instability, amount of pollutant emissions from fossil fuels, carbon-free or carbon-neutral fuels such as H_2, NH_3, methanol, and biofuels, are drawing increasing attention in the current world. Many challenges should be solved with advanced combustion technologies. This subject set advanced combustion technologies including pyrolysis, mild combustion, catalytic combustion and carbon free fuels combustion, diagnostic technologies including flow velocity, species and temperature etc., which will helping to obtain fundamental understanding of the advanced combustion technologies.

Co-combustion characteristics of typical biomass and coal blends by thermogravimetric analysis was reported by Yuan et al. The reaction stages, ignition and burnout temperature, maximum weight loss rate, and different combustion indices of the coal and biomass blends were experimentally determined. The results shown that the value of activation energy and the pre-exponential factor increased with the decreasing biomass percentage in the blends, which can provide data on blending fuels in their combustion applicability. Li et al. reported a comprehensive review on combustion characteristics of ammonia as a carbon-free fuel. The experimental and numerical studies of the application of NH_3 as a fuel during combustion process, including the combustion properties of laminar burning velocity, flame structures, pollutant emissions for the application of NH_3 as a carbon free fuel are summarized, which aims to review and describe the suitability of NH_3 as a fuel. Effects of temperature and additives on NO_x emission from combustion of fast-growing grass has been experimentally investigated by Liu et al. A highest denitration rate of 63.28% has been gotten at SiO_2 addition of 5% and combustion temperature of 600°C. The optimal conditions to limit NO_x emissions at various temperature have been obtained to control the NO_x emissions. Yan et al. and Zhang et al. numerically investigated the injection timing effects on a gasoline direct injection engine performance of in-cylinder combustion process and in-cylinder emission formation and oxidation process, respectively. They concluded that droplet-wall impingement and available duration for mixing were dominant trade-off factors for mixture formation and following combustion process during the whole process from injection to combustion. Furthermore, the fuel–gas mixture was more uniformly distributed and combusted more completely. CO, uHC, soot, and NO_x emission has decreased more than 80% with the injection timing advancing. Zhang et al. proposed a modified conjugate heat transfer model of the combustion chamber and the cooling medium to analyze the temperature distribution of the cylinder heat with the motive of modifying and calibrating the Woschni formula at different altitudes. They pointed out that the modified in-cylinder conjugate heat transfer model can be used to predict the thermal load of diesel engine combustion chamber components under different altitude operating conditions. NH_3 and NO_x interaction chemistry with CH_4 and C_2H_4 at moderate temperature and various pressures was explored by Deng et al. The results showed that the adding of CH_4/C_2H_4, NO/NO_2 ratio and pressure are the main factors to affect NO concentrations. The rate production and sensitivity analyses was performed with a detailed kinetic model. The additional chain-branching pathways regarding NO/NO_2 interconversion were activated with the addition of hydrocarbons because the active radical pool was enriched, the reaction $C_2H_3 + O_2 = CH_2CHO + O$ was crucial reaction to drive the reactivity of $CH_4/C_2H_4/NH_3/NO/NO_2$ mixture. Li et al. studied the effect of wall thickness on the combustion characteristics of non-premixed hydrogen micro-jet flame. They found that the temperature distribution, flame shape, and heat recirculation are changed with the fuel flow velocity were affected by wall thickness. Zhang et al. the combustion characteristics of a laminar non-premixed methane jet flame in oxygen/carbon dioxide co-flow. The simulation results of OH distributions showed good consistency with the results obtained from the experiments. The third-body effect and transport properties of CO_2 didn't exert remarkable effects on the laminar non-premixed flame, while the chemical effect of CO_2 on the laminar non-premixed jet flame was significant.

This Research Topic had a cumulative view of 16,386 at the time of writing this Editorial preface, with 1,862 downloads of the various articles from the researchers all over the world, which show the great interest in the low carbon emissions combustion technologies.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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