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Invited Talk Abstract

Pore Solution: Porous Media Combustion as an Advanced Concept for Carbon-free Energy Utilization

Current combustion technologies are relatively mature, and only incremental improvements in performance and combustion efficiency can be expected. However, new combustion concepts are needed to comply with new regulations on exhaust emissions and to enable the utilization of carbon-free fuels. One such promising combustion concept is porous-media combustion. In these burners combustion is facilitated within the voids of a porous heat-conducting matrix, thereby achieving superadiabatic combustion, significant reductions in pollutant emissions, and extended power modulation.

In this presentation, we will discuss progress in and challenges of enabling porous media combustion for carbon-free fuel utilization by considering four aspects. First, we will present progress on the experimental characterization of the interstitial flame structure using advanced X-ray computed tomography. Second, we will discuss advances on the computational modeling combining high-fidelity simulations and low-order modeling to predict fluid mechanics, gas-phase combustion, conjugate heat transfer, and material response. Third, we will use these models in the design of tailored porous media burners to enable extended operability and fuel-flexible operation. Finally, we discuss the use of additive manufacturing methods to fabricate these tailored burners. We close this presentation by addressing open challenges pertaining to material stability, modeling, and burner integration in practical systems.