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Supercritical Flow and Heat Transfer of Hydrocarbon Fuels

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Abstract

With the rapid development of aerospace engineering and increased requirements of heat management, the challenge of efficient cooling becomes more and more severe. Among various thermal protection measures, regenerative cooling, which uses the onboard fuel to cool some critical components before it is burned in the combustor, is considered to be one of the most promising methods. Due to the harsh environment, the flow and heat transfer of hydrocarbon fuels occurs mostly under supercritical conditions in complex geometries. The demand for increased cooling capacity via chemical heat sink, i.e., thermal cracking of the fuel, and the potential risk of subsequent coke formation further complicated the situation. This talk will give an overview of our work in regenerative cooling, with a focus on supercritical flow and heat transfer under competing chemical reaction conditions. A multiscale framework will be introduced, which integrates from molecular scale understanding of the cracking and coke kinetics, to the macroscale simulation of flow and heat transfer. Different optimisation strategies will be introduced, the challenges and future perspectives will be discussed.