11th Seminar of the Spanish Section of the Combustion Institute

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Title

Turbulence effects on nano-particle formation

Speaker

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Abstract

The effect of turbulence on particle-forming flames is investigated via three-dimensional direct numerical simulations. Premixed and non-premixed methane-air turbulent planar jet flames doped with titanium tetraisopropoxide (TTIP), forming titanium dioxide TiO_2 nanoparticles, are investigated using the sectional model and a finite-rate chemistry approach. These simulations resolve the smallest relevant scales - the Batchelor scales - of the nanoparticle field. The change in particle concentrations due to diffusion, coagulation, and nucleation is defined and characterized by the particle number concentration layers. Several regions of the computational domain with different turbulent intensities are analyzed (see Figure 1), and the effects of the complex normal and tangential strain rates that govern the thickness of particle-number-concentration fronts are evaluated. This information is subsequently used to discuss the physics of how turbulence affects premixed and non-premixed particle-forming flames, to develop transferable models for nanoparticle-synthesis simulations.

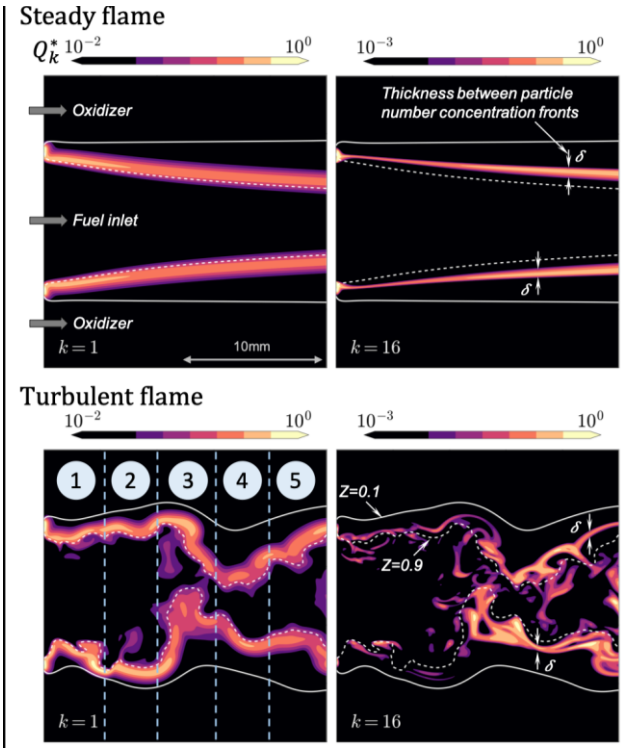

Figure 1: Instantaneous particle number concentration fields Q_k^* from the 3D non-premixed turbulent flame DNS data. Iso-lines represent the values of the mixture fraction $Z = 0.1$ and $Z = 0.9$. Vertical dotted lines mark the limits of the five regions of the computational domain where the results have been analyzed.