

The role of multiple scales in the analysis of combustion processes

A. Liñan¹

ABSTRACT

Combustion processes involve exothermic chemical reactions, usually taking place in the gas phase, after mixing the fuel and the oxygen of the air. The analysis of these processes must be carried out using the conservation laws of gas dynamics, augmented by the laws of mass and energy conservation, including the laws of the transport by diffusion and conduction and the reaction rates provided by chemical kinetics.

The typically large disparity in the time scales associated with the convective or diffusive transport of mass and energy, and the time scales of the reactions leads to the existence of thin transition layers, where the reactions take place. These layers are diffusion flames, when the reactants are initially separated, or propagating deflagration or detonation fronts, when the reactants are premixed before ignition. The strong sensitivity with temperature of the reaction rates plays an important role in the existence and structure of these diffusion flames and of the reactions fronts.

¹Escuela Técnica Superior de Ingenieros Aeronáuticos
Universidad Politécnica de Madrid
amable.linan@upm.es