DFD13-2013-002588

Abstract for an Invited Paper
for the DFD13 Meeting of
the American Physical Society

Supersonic combustion[1]

MIRKO GAMBA, University of Michigan

Combustion in the supersonic regime presents several challenges over what the low-speed counterpart admits. Here we will review some of these challenges, and we will describe some of the key features of one of the canonical flow fields in supersonic combustion: the reacting transverse jet in a supersonic crossflow (JISCF). From a practical standpoint, the key challenges that limit our control of this combustion regime are fast mixing, robust flame holding and stability. In turn, these aspects are controlled by the complex effects introduced by chemistry, compressibility, shocks and shock/flow interactions, turbulence and the underlying coupling among them. Some of their properties will be discussed here. In particular, for a JISCF in a Mach 2.4 high enthalpy crossflow, the reaction zone structure, its dependence on near-wall events, boundary layer, and shock/boundary layer interaction will be described. We will demonstrate the paramount importance of the coupling between boundary layers and compressibility to provide mechanisms for flame stabilization at the wall. Mixing characteristics, overall structure, and the link to global parameters (momentum flux, velocity and density ratios) that characterize the JISCF, and possibly free shear supersonic flows in general, will also be highlighted from non-reacting experiments.

[1]Sponsored by DoE PSAAP at Stanford University