Experimental observations of Shock-flame interactions: New Facility at CNRS-ICARE

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Abstract

The problem of the interaction of shocks with flames has been recognized to be of prime importance in most reactive compressible flows for practical applications and for safety issues. This phenomenon is central to practical problems ranging from deflagration to detonation transition (DDT) to supersonic propulsion applications. A new facility is being built to study these phenomena with the support of the French national science foundation, ANR-PHYSSA, Grant agreement no. ANR-20-CE05-0014-01.

This new facility consists mainly of a rectangular section which was designed to allow its integration to a round shock tube used in many previous studies at ICARE (Institut de Combustion, Aérothermique, Réactivité et Environnement) [1]. The shock wave starts to be generated after the burst of a double diaphragm, and a cookie-cutter allows the transition from a round to a rectangular cross-section. The configuration allows the head-on collision between an initially laminar flame (generated by a spark plug or a hot wire) and the shock wave. The section was designed by considering the maximum pressure achieved behind reflected shock waves.

With this new section, the quantification of changes in the flame surface and burning velocity caused by the shock - flame interaction is possible using Schlieren visualization. In addition, the design allows to get shock wave velocity, which is measured by means of pressure transducers distributed (flush mounted) along different sections of the tube.

The experiments are performed at low initial pressures (P_1 = 0.2 bar) and with equivalence ratios around to stoichiometric for mixtures of hydrogen (H_2) and air. Actually, the characterization of the time and conditions to avoid detonation is underway.

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References

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