

SPACE PROPULSION SYMPOSIUM (C4)  
Hypersonic and Combined Cycle Propulsion (5)

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SPARK IGNITION AND FLAME PROPAGATION IN A LOW PRESSURE RAMJET COMBUSTOR  
WITH CAVITY**Abstract**

The theory of edge flame is used to explain flame propagation phenomena and stabilization mechanism in non-premixed flames, in which the bulk flow velocity is higher than the laminar flame. In practical fire system, the flow field is finding more complicated than the simplified co-flow flame where fuel inject into air coaxially. For example, the fuel sometimes inject vertically into high speed air flow such as ramjet and scramjet. The experimental results when ignited by a spark is scared but valuable for analysis of the flame holding process in such engine device. So the characteristics of edge flame propagation in a subsonic crossflow was investigated experimentally. The temperature of the subsonic inflow air was about 300k, with a speed of 10 100m/s. The liquid and gas fuel were sparked by a high energy plug. The position downstream the fuel injection port can be varied to find a flammable place. The behavior of drops dispersing in the spark region was tracked by Malvern Particle Analyzer. The drops distribution density and SMD (Sauter Mean Diameter) was obtained. NPLI (Nanoparticle-based Planar Laser Imaging) was designed to extract the message of fuel edge of penetration, which also may indicate the degree of mixture to some extent. These information of flow field are valuable for the analysis of ignition result. The evolution of kernel was especially emphasized and recorded by a high speed camera, with exposure time of 100ns. The difference between fail and successful flame propagation were compared. Results found that small SMD and suitable penetration height gives a successful kernel generation and subsequent spread with last flame establishment. After a certain delay time of spark, the kernel propagated along with the edge of fuel jet where finding the fuel concentration and low scalar dissipation. The flame anchored a distance downstream or the wall boundary where a recirculating zone existed.