Paper ID: 91570
interactive
student

IAF SPACE PROPULSION SYMPOSIUM (C4)
Late Breaking abstracts (LBA) (LBA)

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EXPERIMENTAL STUDY OF POROUS-WALL EXPANSION-DEFLECTION NOZZLE FLOW

Abstract

An experimental study on cold flow is conducted for a planar expansion-deflection (ED) nozzle with a partially porous material wall in the expansion section. The objective is to validate the thrust compensation performance and inhibit the shock flapping behavior. The experimental results indicate that during the nozzle operation, the porous wall absorbs air from the outside, resulting in free shock separation with the separation point located upstream compared to the conventional ED nozzles. The increase in wall pressure after the separation point is the mechanism behind thrust compensation, resulting in a 15.8% increase in thrust. Moreover, the supersonic flow, which no longer expands along the shroud wall, avoids the nonlinear flapping behavior of shock wave and suppresses thrust oscillations. This newly designed nozzle addresses the common issue of thrust oscillation in ED nozzles under low backpressure conditions and effectively improves the launch capability of the vehicle.