Analysis of Flow Behavior and Performance of an Endwall Injection System in a Shock Tube

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For several decades, the repeatable, high-temperature conditions achievable behind reflected shock waves have been utilized for studying chemical kinetics in a wide variety of gaseous mixtures. In addition to homogenous mixtures, shock tubes have also been utilized for studying heterogeneous mixtures containing solid or liquid particles. However, such heterogeneous shock-tube tests are inherently more difficult and require additional effort to characterize the quality of test conditions such as the uniform dispersion, repeatability, and accurate characterization of the environment pre- and post-shock. Recently, the authors' laboratory has demonstrated an endwall injection scheme to introduce, in a relatively simple manner, very low-vapor-pressure substances such as lubricating oil into the reflected-shock region. Although the injection mechanism has been successfully demonstrated in preliminary studies, a detailed fluid mechanical understanding of the transient jet behavior remains lacking, particularly as the system scaled to a range of initial shock-tube full pressures (p_1) and injection pressure (p_{inj}). This poster presents a series of experiments performed using the injector method to visualize and characterize the jet dynamics over a range of conditions. Quantifying these parameters will provide a base in which to improve the maximum dispersion of the material as well as the repeatability of the test conditions. The primary goal of this work is to gain an understanding of the interaction between the endwall pulsed injection system over a range of pressures which will enable future experiments to include reactive tests with low-vapor-pressure fuels under conditions typically found in practical propulsion and power generation applications.