EXPERIMENTAL INVESTIGATION OF COMBINED TRANSPIRATION AND JET COOLING OF SINTERED METAL POROUS STRUTS

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The scramjet combustion chamber provides the propulsion for hypersonic vehicle. The fuel is combusted in the chamber to generate thrust. The strut is used to inject fuel into the core of combustion chamber to enhance the mixing and the combustion. The mainstream in a scramjet combustion chamber is at supersonic velocity and high temperature. The tremendous aerodynamic heating will then cause ablation of the strut without adequate cooling. Therefore, effective thermal protection methods must be provided for the strut, especially for the leading edge. Transpiration cooling is one of the most effective cooling methods to protect surfaces at high heat flux conditions, and can effectively protect most part of the strut, but some ablation was found at the strut leading edge. Therefore, more effective cooling method is needed to protect the strut, especially the leading edge. Opposing jet cooling is an effective cooling method to protect the leading edge.

This paper describes a particular experimental study of cooling using both transpiration and opposing jet cooling to protect the strut. The strut material was sintered stainless steel with a micro-slit on the leading edge as shown in Fig. 1. The micro-slit width is about 0.1 mm through Linear Cutting. The influences of the micro-slit width and coolant injection pressure on the cooling effectiveness were studied. The effect of non-uniform injection pressures was also investigated. The results showed that the combined transpiration and opposing jet cooling can effectively protect the strut.

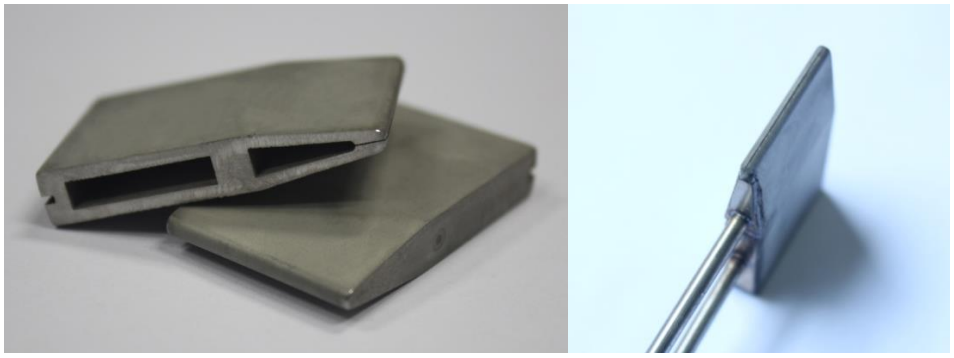

Figure 1 – Sintered metal porous struts with a micro-slit on the leading edge