An Experimental Study of Heat Transfer and Effectiveness on the Endwall of a Vane Passage Using Paired Film Cooling Flow

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ABSTRACT

This research concerns about a new film cooling technique and the feasibility of its application to the protection of the endwall in a vane passage. This new technique utilizes pairs of coolant jets impinging against each other to form more aggregated and more uniform distribution of the film cooling effectiveness. The experimental results by using this technique are compared to those with parallel jets at the same coolant flow rate, endwall entrance condition, and the blowing ratio. In the experiments, the endwall of a vane passage was tested. Liquid crystal thermography was employed to measuring the distributions of local heat transfer coefficient （HTC）and film cooling effectiveness. The Reynolds number of the main flow was fixed at . The blowing ratio was set be 0.5, 1.0, 2.0. The investigated entrance conditions include a smooth endwall, an endwall with a forward-facing entrance step, and an endwall with a backward-facing step. Results show that the pattern of the HTC distribution could be altered by the overall arrangement of the cooling holes. However, the HTC values did not change much. In the case of film cooling, the new technique with offset impinging cooling jets provides longer coverage area by the coolant, and the protected region is shifted towards the suction wall. This new technique is less sensitive to the blowing ratio and the entrance condition of the endwall compared to the design with parallel coolant jets. Hence, it is a better technique.

Keywords : offset impinging cooling jets, endwall, film cooling effectiveness, liquid crystal thermography

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