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Author: Mr. Ai Bang cheng
China, siyuanbuaa@163.com

Mr. Chen Siyuan
China Academy of Aerospace Aerodynamics (CAAA), China, siyuanbuaa@163.com
Dr. Min Chu
China Academy of Aerospace Aerodynamics (CAAA), China, chumin_caaa@126.com

AN ACTIVE AND PASSIVE COMBINED THERMAL PROTECTION TECHNOLOGY FOR FLOW DISTRIBUTION IN PARALLEL CHANNELS

Abstract

Multi-branch parallel channels have been a common structure in the regenerative cooling of scramjet. The flow is prone to mal-distribution because the flow resistance is always different between different branches which may cause over-temperature of the scramjet. A numerical program has been developed which is suitable for the simulation of low-speed compressible flow. The influence on flow distribution of different channel structures has been analyzed by the program. The results show that a poor design of channel structures can induce flow mal-distribution even when the heat flux is small. An optimized design can alleviate this problem. A new active and passive combined thermal protection technology is proposed, which combines heat pipe cooling and regenerative cooling. The rapid heat transfer characteristics of the heat pipe can effectively suppress the non-uniformity of temperature distribution. As a result, the positive feedback mechanism of flow mal-distribution can be destroyed. With a well optimized channel structure, the active and passive combined thermal protection technology can significantly improve the flow distribution characteristics of multi-branch parallel channels.