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航空燃气涡轮冷气掺混流动损失的数值研究

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Study on the Flow Loss on Turbine Blade with Coolant Ejection

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摘要

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摘要 采用理论分析的研究方法,对不同冷气掺混形式造成的涡轮气动性能的变化进行了数值计算研究。针对气膜冷却所造成的流动损失,采用修正的Ito等压混合模型;而针对尾缘冷气喷射所造成的流动损失,则采用了修正的Schoberi流动损失模型。对于不同的冷却方式,假定它们之间对主流造成的流动损失是相互独立。以某高压涡轮导向器作为研究对象,分析了各种冷气参数和几何参数对冷气掺混过程的影响规律。研究结果表明,涡轮叶片气冷过程引起的叶栅总压损失随冷气入射角度、吹气比、混合层厚度的变化而显著变化,通过优化设计可以使气冷过程造成的流动损失最小。

关键词: 混合层 总压损失 气膜冷却 吹气比

Abstract: A theoretical analytical method is presented to investigate the characteristics of the turbine with different mixtures of cooling air. The improved Ito's loss model is used to calculate the flow loss caused by film cooling, and the flow loss generated by the coolant ejection at trailing is computed with the Schoberi's loss model. Suppose that the flow losses are caused by different types independently and the total flow loss is the sum of their flow losses. The effects of different cooling air parameters and geometry parameters on the loss and performance for a high-pressure turbine are presented. The results show that the total pressure loss varies greatly with the coolant eject angle, the blow ratio and the thickness of mixing layer. It is supposed that the minimum flow loss is obtained by optimum design.

Keywords: mixing layer total pressure loss film cooling blow ratio

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