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旋转状态下叶片前缘复合换热实验

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Experiments of combined heat transfer in leading of blades at rotating state

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摘要 通过液晶示温瞬态实验方法,对旋转状态下涡轮叶片前缘带气膜出流的冲击冷却结构的换热特性进行了研究,获得了哥氏力、离心力对复合换热效果的影响.实验参数:射流进口雷诺数 $Re=4\ 000$,旋转数 $Ro=0\sim 0.139$.实验结果表明:随着旋转数的升高,实验模型的整体换热效果逐渐减弱,在旋转数为0.139时,与静止状态相比冲击面平均努塞尔数 Nu 下降了33%,压力面和吸力面分别下降了20.5%和7.5%;哥氏力的作用加速了射流的扩散,是造成旋转换热减弱的主要原因;哥氏力和离心力的共同影响使得吸力面的换热好于压力面;气膜孔的存在改变了流动结构,极大的增强了孔周边区域的换热效果.

关键词: 冲击 气膜 换热 瞬态实验

Abstract: Transient experiment was performed to study the heat transfer characteristic of impingement cooling with outflow film in the leading of turbine blades at rotating state. And, the effect of Coriolis forces and centrifugal forces on combined heat transfer effectiveness was discussed. The Reynolds number based on the inlet velocity of the impinging jet and hole diameter is 4 000. The Rotation number is from 0 to 0.139. Experiments' results show that the heat transfer effectiveness decreases with the Rotation number increasing. The average Nusselt number on the impingement face decreases 33%, and the average Nusselt number on the pressure face and the suction face decreases 20.5% and 7.5%, respectively. The effect of Coriolis forces enhance the spreading rate of the jet flow, which is mostly factor that result in heat transfer characteristic down. The effect of Coriolis forces together with centrifugal forces arouses the difference of heat transfer on pressure face and suction face at rotating state, and the average Nusselt number on the suction surface was larger than that on the pressure surface. The presence of the film holes changes the flow structure and gathers head the heat transfer effectiveness of films'border area.

Keywords: [impinging film](#) [heat transfer](#) [transient experiment](#)

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