

# 交叉噴流薄膜冷卻技術應用在彎曲表面有效性之探討

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## 摘要

本論文以液晶熱像穩態實驗方法探討交叉噴流薄膜冷卻技術應用於凹面與凸面之有效性，以平板的情形做比較基礎，藉以了解該技術應用於氣渦輪機葉片彎曲表面外部冷卻之可行性。為了製造葉片端壁二次流渦旋的現象，本研究利用三角翼所產生的其中一支熱氣渦旋模擬之，以了解單一熱氣渦旋與交叉噴流膜冷卻渦旋的作用機制。本實驗固定膜冷卻孔之孔徑(7 mm)、孔距與交叉噴流夾角(120度)，主流速度為6 m/s、8 m/s、10 m/s，相當於弦長241 mm葉片之雷諾數分別為 $9.2 \times 10^4$ 、 $1.24 \times 10^5$ 、 $1.5 \times 10^5$ ，吹氣比為0.5、1、2，二次流渦流型式則使用三角翼渦流產生器產生不同轉向的上掃渦旋及下掃渦旋。實驗結果顯示，雷諾數與吹氣比對於平板交叉噴流膜冷卻之影響趨勢與文獻相符。吹氣比從0.5增加到1時，膜冷卻有效性可提升，但是吹氣比增加到2時，在膜冷卻孔出口處會有分離流，導致有效性下降，此情形以凹面最為嚴重。由於本實驗之交叉噴流渦旋主要形成逆時針旋轉前進渦旋(由上游往下游看)，主流的上掃渦旋有助於加強交叉噴流渦旋而提升其有效性，下掃渦旋則會減弱交叉噴流渦旋進而降低其有效性。無論是凸面或凹面曲率均使得交叉噴流渦旋更不容易貼覆冷卻表面，造成膜冷卻有效性下降，此影響也是以凹面最為嚴重。

關鍵詞：交叉噴流、三角翼渦流產生器、薄膜冷卻、彎曲表面、液晶熱像

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